DOCUMENT RESUME

ED 314 623	CE 053 982
TITLE	Trade and Technical Volumes I: Access Skills. Vocational Readiness Skills. Missouri LINC. Assessing Vocational Education.
INSTITUTION	Missouri Univ., Columbia. Dept. of Practical Arts and Vocational-Technical Education.; Missouri Univ., Columbia. Dept. of Special Education.
SPONS AGENCY	Missouri State Dept. of Elementary and Secondary Education, Jefferson City.
PUB DATE	Nov 88
NOTE	347p.; For related documents, see CE 053 979-990.
AVAILABLE FROM	Instructional Materials Laboratory, 10 London Hall, University of Missouri-Columbia, Columbia, MO 65211 ($22.00).
PUB TYPE	Guides - Classroom Use - Guides (For Teachers) (052)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	*Access to Education; Air Conditioning; Carpentry; Commercial Art; Communication Skills; Competency Based Education; Drafting; *Educational Diagnosis; Educational Objectives; Electronic Technicians; Employment Potential; Heating; Interpersonal Competence; Mathematics Skills; *Occupational Information; Printing; Refrigeration; Secondary Education; *Special Needs Students; *Trade and Industrial Education; Vocational Aptitude; Vocational Education; Vocational Evaluation; Vocational Maturity
IDENTIFIERS	*Missouri

ABSTRACT

This document contains trade and industrial occupations-related materials to help teachers and parents teach access skills to Missouri junior high and high school special needs students who want to pursue a vocational program in carpentry; commercial art; drafting; electronics; heating, air conditioning, and refrigeration; or offset lithography and printing. Access skills are defined as those skills needed to access vocational education programs and be successful in the world of work. An introduction explains this document's relationship to other documents about Missouri vocational education and describes the document's contents. The next six sections contain competency lists, skills checklists on which teachers can record student competency, and instructional activities relevant to the six vocations. The activities cover each of the five major areas (math, physical demands and working environment, aptitudes, temperament, and vocational) of Missouri's Vocational Readiness Inventory. Glossaries, tool lists, teacher and student worksheets, and lists of resources are included. The document concludes with 10 instructional modules that teach how to apply basic measurement concepts, use basic first aid, become familiar with occupational vocabulary, figure square feet and cubic feet, identify and use tools, identify colors, perform basic operations using decimals and percents, perform basic operations using fractions, perform physically demanding movements, and recognize and read blueprints. The modules include task analysis sheets and directions for instruction. (CML)

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ACCESS SKILLS

Vocational Readiness Skills for
Trade and Technical I

Missouri linc

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The project which is the subject of this handbook was supported in whole by funds from the Missouri Department of Elementary and Secondary Education. However, the opinions expressed herein do not necessarily reflect the position or policies of the Missouri Department of Elementary and Secondary Education and no official endorsement should be inferred.

November, 1988

This Book is Available From:
Instructional Materials Laboratory
10 London Hall
University of Missouri-Columbia
Columbia, MO 65211

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1-800-392-7217

ACKNOWLEDGEMENTS

Missouri LINC would like to express appreciation to all vocational education and special education instructors who have helped create the ACCESS SKILLS: Vocational Readiness Skills manuals. Ideas for activities came from many people who, as practitioners in the field, have first-hand knowledge of effective methods which meet the needs of students. Their dedication to special needs students provides valuable assistance to Missouri LINC staff in the development of resources and materials which enable students to become the best they can be.

A special thanks to our contributing authors who gave us some of the activities found in the manual:

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Donna Kearns, Instructor, Missouri LINC, Columbia, Missouri;

And to those who wrote modules for the original Entry Level Skills manual: Kathy Hartman, Carol Gillis, Jill Hastings, Lynn Barnett, Marilyn Lyles, Ann Wall, Carol French, Mary Hughes, Bernard Rothrock, and JoAnn Thomas.

We are grateful to LINC staff members,

Jan Wheeler, Graduate Research Assistant, and

David Gray, Instructor,

for their proofreading and editing comments, as well as to our typist, who also helped in editing,

Victoria Bowlin, Senior Clerk Typist.

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INTRODUCTION

Since 1981, Missouri educators have been utilizing the Entry Level Skills Criteria (ELSC) Manual to help prepare special needs students for entry into and successful completion of vocational training programs. With the passage of the Carl D. Perkins Vocational Education Act (P.L. 98-524), the Missouri mandate for instructional management systems and competency-based education, there was a need to revise the ELSC Manual. These revisions make the materials more compatible with the recent educational changes and better meet the needs of practitioners in the field. ACCESS SKILLS is the new name for the ELSC.

ACCESS SKILLS: Vocational Readiness Skills are defined as those skills which appear to be correlated to success in vocational education programs. If a student acquires as many of these skills as possible, the chances of success are higher for the chosen vocational program. The ACCESS SKILLS: Vocational Readiness Skills are negotiable skills; that is, students who are deficient in one or more areas may still enter vocational programs. Through assessment, these weak areas will be determined and vocational instructors and support personnel can then continue to work on the skills during vocational training. There has been a great deal of confusion with the original term "entry level skills". This terminology in vocational education usually refers to the skills needed to enter the world of work. ACCESS SKILLS better explains the objective: to identify, assess and teach skills needed to access vocational education programs and be successful in the world of work.

The ACCESS SKILLS are available in several manuals:

ACCESS SKILLS: Vocational Readiness Skills Inventory for Special Needs Students (Revised Entry Level Skills Inventory)

ACCESS SKILLS have been identified for vocational programs listed on the Vocational Administrative Management System (VAMS). Skill areas include math, physical demands/working environment, aptitudes, temperament and vocational. Sample occupational areas, Classification of Industrial Programs (CIP) codes, and Dictionary of Occupational Titles (DOT) codes have been included as well as employability and study skills. The ACCESS SKILLS lists will also be included on VAMS.

ACCESS SKILLS: Employability and Study Skills Assessment and Curriculum Guide

This guide includes informal assessment instruments to evaluate thirty-five employability and study skills with instructional activities included to teach each skill. This guide was designed for junior high students, but is applicable to any secondary student with needs in these areas.

ACCESS SKILLS: Generic Informal Assessment Instruments and Checklist

This manual contains informal assessment instruments for each of the ACCESS SKILLS: Vocational Readiness Inventory and a checklist for documenting the assessment.

ACCESS SKILLS: Vocational Readiness Series

ACCESS SKILLS: Vocational Readiness Skills for Agriculture

ACCESS SKILLS: Vocational Readiness Skills for Business & Office

ACCESS SKILLS: Vocational Readiness Skills for Marketing & Cooperative Education

ACCESS SKILLS: Vocational Readiness Skills for Health Occupations

ACCESS SKILLS: Vocational Readiness Skills for Occupational Home Economics

ACCESS SKILLS: Vocational Readiness Skills for Trade & Technical I and II

The ACCESS SKILLS: Vocational Readiness Skills manuals were developed by occupational cluster areas and include the lists from the Vocational Readiness Skills Inventory for Special Needs Students as well as activity suggestions and instructional modules for teaching the different skills necessary for each program area.

MANUAL COMPONENTS

VIMS COMPETENCY LIST

This list is found at the beginning of each program area. Each list contains the exit level skills from the program area taken from the standardized Vocational Instructional Management System (VIMS). Vocational instructors will train students in the majority of these skills and may add skills for an individual student or for all students. It is important to note that not all students must master all of the competencies. The Individual Educational Planning (IEP) team can decide which competencies a student is able to master at what level of acceptance in a given time period. The specified competencies should be designed to lead to a job; that is, a student should be able to learn skills necessary for a job in the community. These competency lists are included so that:

(1) the teacher, student, and parent may see in advance the types of skills which will be presented to students. In this way, the IEP team may have a better idea if the vocational area is reasonable and appropriate for the student;
(2) the relationship between the ACCESS SKILLS: Vocational Readiness Inventory and the exit level competencies can be better understood. For example, in the Electronics area:

ACCESS SKILLS Vocational Readiness Inventory	VIMS Exit Competency
MATH Use basic measuring intruments, rulers, scales, etc.	Demonstrate use of an oscilloscope Demonstrate use of multimeters
PHYSICAL DEMANDS/WORKING ENVIRONMENT Sieze, hold, grasp, turn or otherwise work with the hand or hands	Practice safe soldering methods Identify and replace parts and components on printed circuit boards and chassis
APTITUDES Make visual comparisons and discriminations and see slight differences (P-form perception)	Identify and test resistors, capacitors and inductors
TEMPERAMENT Situations requiring the precise attainments of set limits, tolerances or standards	Determine diode specifications for specific installations
VOCATIONAL Identify basic hand tools and equipment	Demonstrate safe and proper use of hand tools

The ACCESS SKILLS: Vocational Readiness Inventory lists are very basic skills which are needed across vocational areas; therefore, many of them are the same, even across different vocational areas. However, if a student possesses these basic skills, then the outcome skills (VIMS exit competencies) will be easier for the student to attain.

ACCESS SKILLS CHECKLISTS

Each vocational program manual will contain a summary checklist of the skills needed for the area the student wishes to pursue. After assessing the skills with the ACCESS SKILLS: Generic Informal Assessment Instruments, or other formal or informal assessments, the teacher can transfer the information obtained onto the summary checklist. On the checklist, each ACCESS SKILL is broken down into its component parts and the teacher will designate the student's performance or ability by circling the appropriate mastery code number.

3 = mastery
2 = requires supervision
1 = not mastered
N = no exposure

There is room on the checklist to fill in a mastery date as well as a re-entry code and date for mastery later in the year. After completion of the assessment, the areas of weakness can and should become goals in the IEP. This checklist should be sent to the Area Vocational School as part of the student's application. The codes (3, 2, 1, N) can be entered into the VIMS system if the vocational school desires to follow the student's mastery of skills.

A student does NOT have to show mastery of every skill on the ACCESS SKILLS list in order to enter a vocational program. These skills are negotiable and can continue to be practiced during vocational training. The deficient areas should help the planning team in developing realistic vocational goals and objectives and appropriate vocational training for the student. They also should help vocational personnel identify what skills still need to be practiced and/or what curriculum modifications need to be made to insure the success of the student.

Students with physical limitations may never achieve some of the ACCESS SKILLS, especially in regards to dexterity and other physical demands. This does not preclude them from entering and succeeding in an appropriate vocational area. In these cases, the teacher should make a comment regarding the compensatory techniques the student uses (i.e., strikes typewriter with pencil instead of fingers) and list any modifications that might be needed (i.e., typewriter template, longer time to complete assignments, etc.).

INSTRUCTIONAL ACTIVITIES

This section in each manual is designed to give teachers suggestions for activities that may be used to teach and develop a student's weaker skills found during the assessment. It is assumed that students entering vocational programs have fundamental math skills such as counting, adding, subtracting, multiplying, and dividing one place numerals. The activities usually begin with more advanced skills (working with two place numbers), and all are related to the specific program area the student has chosen.

Each of the five major areas of the ACCESS SKILLS: Vocational Readiness Inventory are covered (math, physical demands/working environment, aptitudes, temperament, and vocational). The activities often overlap, but repetition of previously learned material is often helpful for special needs students. For example, the majority of activities require dexterity skills (writing food orders, typing, handling boxes of different weights). Some activities require basic math skills in adding column totals, etc. However, since the activities are related to job tasks in the vocational area many students will not notice the overlap of skills. Teachers are encouraged to be innovative in developing other activities to enhance the student's ability in any specific area.

The activities include suggestions for parents, and most are written so as to be easily utilized as IEP goals or objectives. The criterion level for mastery is not included, as each student's expected level may differ.

Within each vocational program area a vocabulary list is provided, as well as a tool list, when appropriate. In addition, when worksheets for activities are provided, they are found at the end of the section (math, physical demands, etc.).

INSTRUCTIONAL MODULES

These modules are related to the vocational program area, and have been revised from the instructional modules found in the Entry Level Skills Criterion Manual. Some of the modules can also be found in the ACCESS SKILLS: Employability and Study Skills Assessment and Curriculum Guide, but have been adapted to the specific vocational program area.

RESOURCE MATERIALS

At the end of each program area, a list of resource materials is provided to help supplement the activity suggestions. Names and addresses of publishers are included. An Area Vocational School may already have some of these materials, as might other teachers in the building, so it would be advisable to check with other teachers prior to purchasing.

CARPENTRY

Sample Occupational Areas:
- Brick Layer Helper
- Cabinet Maker, Apprentice
- Construction Worker
- Electrician Helper
- Roofer
- Rough Carpenter

Introduction

The field of carpentry offers a wide variety of job opportunities. Individuals with an interest in working with their hands and creating things can find satisfaction in this profession. Either an indoor or an outdoor environment is associated with carpentry. Individuals will use both fine and gross motor skills, work with wood construction, electricity and plumbing. It is a field which has sessional emphasis but even during off season times an individual with carpentry skills can find work.

VIMS COMPETENCIES FOR CARPENTRY

A. Basic Skills

1. Demonstrate good safety practices
2. Identify and use measuring and layout tools
3. Read a rule
4. Identify proper use of power and hand tools
5. Identify and use nails and fasteners
6. Use pneumatic tools safely
7. Estimate square feet
8. Estimate linear feet
9. Estimate cubic feet
10. Construct scaffolding
11. Identify methods and materials for thermal insulation
12. Identify types and qualities of exterior protective coatings
13. Identify purposes of building codes, zoning laws and building permits

Other (specify):

____

____

____

B. Planning for Construction

1. Read and interpret working drawings
2. Interpret blueprint symbols
3. Identify the steps of the building process
4. Estimate labor costs
5. Identify grades of lumber and plywood
6. Organize building materials

Other (specify):

____

____

____

C. Preparing the Building Site

1. Use Builder's level
2. Establish elevation reference points from Bench Mark
3. Layout building

Other (specify):

____

____

____

D. Building and Installing Forms

1. Construct footing forms
2. Install keyway for footing and foundation
3. Erect plywood panel wall forms
4. Erect manufactured wall forms
5. Construct concrete stair forms
6. Construct box for specified (special) openings
7. Strip forms
8. Layout and install anchor bolts in concrete
9. Install bulkhead
10. Install expansion and contraction joint
11. Set screeds
12. Waterproof foundation
13. Build and install forms for horizontal concrete

Other (specify):

____

____

____

E. Floor Layout and Framing

1. Install termite shield
2. Install lally post
3. Install beam
4. Install sill plate and sealer
5. Construct sill box
6. Install floor joists
7. Frame floor opening
8. Install subfloor
9. Install cross-bridging

Other (specify):

____

____

____

F. Wall Layout and Framing

1. Construct corner post
2. Construct partition studs
3. Frame openings
4. Install diagonal bracing (wind brace)
5. Align and brace wall
6. Install backing for hanging fixture and cabinet
7. Install exterior wall sheathing
8. Install metal studs

Other (specify):

____

____

____

G. Roof Layout and Framing

1. Install ceiling joists
2. Install ridgeboard
3. Layout, cut and install common rafters
4. Install roof trusses
5. Layout, cut and install hip rafters
6. Layout, cut and install valley rafters
7. Layout, cut and install tail rafters
8. Layout, cut and install cripple jack rafters
9. Layout, cut and install hip jack rafters
10. Layout, cut and install valley jack rafters
11. Frame dormers
12. Layout, cut and install gable studs
13. Construct intersecting gable roof
14. Apply roof sheathing
15. Install collar beams
16. Frame roof openings
17. Layout, construct and install knee wall
18. Construct box cornice
19. Construct rake cornice

Other (specify):

____

____

____

H. Installing Roofing Components

1. Install roofing felt
2. Install chimney flashing
3. Install step flashing
4. Install valley flashing
5. Install roof vent
6. Install drip cap
7. Install skylight
8. Install composite strip shingles
9. Install composite shingles in valley
10. Install composite shingles around roof opening
11. Install shingles over dormer or roof appendage
12. Install composite shingles on ridge cap
13. Install ridge vent
14. Install wood shingles or shakes
15. Install wood shingles or shakes in valley
16. Install wood shingles or shakes around roof openings
17. Install wood shingles or shakes on ridge cap

    Other (specify):

I. Installing Exterior Finishes

1. Install wood jamb window unit
2. Install exterior door jamb
3. Case exterior opening
4. Hang exterior door
5. Install weatherstripping
6. Install pre-hung exterior door
7. Install drip cap
8. Install wood louvers
9. Install metal or vinyl siding
10. Install wood siding
11. Install wood shingles/shakes on walls
12. Install metal or vinyl soffit
13. Install wood soffit
14. Install metal or vinyl fascia
15. Install wood fascia
16. Construct and install column
17. Install prefabricated column
18. Install prefabricated storm doors and windows
19. Install fixed exterior shutters
20. Apply caulk and glazing compounds
21. Install gutters
22. Install downspout (leader)
23. Install metal newel post and railing
24. Install wood newel post, balusters and railings
25. Layout, cut and install porches and decks

    Other (specify):

J. Installing Interior Finishes

1. Install underlayment over subfloor
2. Install parquet flooring
3. Install plank flooring
4. Install tongue and groove flooring
5. Install batt insulation
6. Install vapor barrier
7. Hang drywall (gypsum) over wood or metal studs
8. Install interior door jamb
9. Trim interior doors
10. Trim interior windows
11. Case interior openings
12. Install pre-hung door unit (split jamb)
13. Install double-acting door
14. Install folding (accordion) door
15. Install sliding door
16. Install bi-fold door
17. Install pocket door
18. Install threshold
19. Install cylinder lock set
20. Install mortise lock set
21. Install deadbolt lock
22. Install door closer
23. Install flush bolt
24. Install door plate
25. Install door stops
26. Install shelving
27. Install closet accessories
28. Assemble prefabricated cabinets
29. Install wall cabinet
30. Install base cabinet
31. Install countertop and backsplash
32. Install medicine cabinet
33. Install wall paneling
34. Install baseboards
35. Install suspended T-grid ceiling
36. Install suspended concealed grid ceiling
37. Install ceiling molding
38. Install disappearing stair unit
39. Set metal window frame
40. Set metal door frame

    Other (specify):

K. Assembling and Constructing Stairs

1. Layout, cut and install stringers
2. Install treads and risers
3. Construct box stairs
4. Install wood newel post, balusters and railing (handrail)
5. Install metal newel post and railing (interior newel post)
6. Install prefabricated stairs
7. Install skirtboard

    Other (specify):

Leadership Competencies **

1. Demonstrate an understanding of VICA, its structure and activities
2. Demonstrate an understanding of one's personal values
3. Perform tasks related to effective management skills
4. Demonstrate interpersonal skills
5. Demonstrate etiquette and courtesy
6. Demonstrate effectiveness in oral and written communications

7. Develop and maintain a code of professional ethics
8. Maintain a good professional appearance
9. Perform basic tasks related to securing and terminating employment
10. Perform basic parliamentary procedures in a group meeting

** (Note: These competencies are addressed in the Missouri VICA Curriculum Guide lessons.)

CARPENTRY
ACCESS SKILLS CHECKLIST

Student Name/ID ______________________ Sending School ______________________

Instructor ______________________ Date(s) Evaluated ______________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
1 = NOT MASTERED N or blank = NO EXPOSURE

TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
1. Count two-place numbers	460200A001	3 2 1 N	________	________
2. Add two-place numbers	460200A002	3 2 1 N	________	________
3. Subtract two-place numbers	460200A003	3 2 1 N	________	________
4. Perform standard units of measurement, i.e., cup, pint, quart, inch, foot, yard, ounce, pound	460200A004	3 2 1 N	________	________
5. Use basic measuring instruments, i.e., rulers, scales	460200A005	3 2 1 N	________	________
6. Multiply two-place numbers	460200A006	3 2 1 N	________	________
7. Divide two-place numbers	460200A007	3 2 1 N	________	________
8. Add common fractions	460200A008	3 2 1 N	________	________
9. Subtract common fractions	460200A009	3 2 1 N	________	________
10.. Multiply common fractions	460200A010	3 2 1 N	________	________
11. Divide common fractions	460200A011	3 2 1 N	________	________
12. Add two-place decimals	460200A012	3 2 1 N	________	________
13. Subtract two-place decimals	460200A013	3 2 1 N	________	________
14. Multiply two-place decimals	460200A014	3 2 1 N	________	________
15. Divide two-place decimals	460200A015	3 2 1 N	________	________
16. Add surface areas, values, weights and measures	460200A016	3 2 1 N	________	________
17. Subtract surface areas, values, weights and measures	460200A017	3 2 1 N	________	________
18. Multiply surface areas, values, weights and measures	460200A018	3 2 1 N	________	________
19. Divide surface areas, values, weights and measures	460200A019	3 2 1 N	________	________
20. Lift 50 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 25 lbs. (Medium work)	460200B001	3 2 1 N	________	________
21. Ascend or descend, i.e., ladders, stairs, scaffolding, using the feet and legs and/or hands and arms (climbing)	460200B002	3 2 1 N	________	________
22. Maintain body equilibrium to prevent falling when walking, standing, crouching or running (balancing)	460200B003	3 2 1 N	________	________
23. Bend body downward and forward by bending the spine at the waist (stooping)	460200B004	3 2 1 N	________	________

CARPENTRY
ACCESS SKILLS CHECKLIST

Student Name/ID ____________________ Sending School ____________________

Instructor ____________________ Date(s) Evaluated ____________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
1 = NOT MASTERED N or blank = NO EXPOSURE

TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
24. Bend legs at the knees to come to rest on the knee or knees (kneeling)	460200B005	3 2 1 N		
25. Bend body downward and forward by bending the legs and spine (crouching)	460200B006	3 2 1 N		
26. Move about on the hands and knees or hands and feet (crawling)	460200B007	3 2 1 N		
27. Extend the hands and arms in any direction (reaching)	460200B008	3 2 1 N		
28. Seize, hold, grasp, turn or otherwise work with the hand or hands (handling)	460200B009	3 2 1 N		
29. Pick, pinch, or otherwise work with the fingers (fingering)	460200B010	3 2 1 N		
30. Perceive size, shape, temperature or texture of objects and materials by using fingertips (feeling)	460200B011	3 2 1 N		
31. Ability to work both inside and outside	460200B012	3 2 1 N		
32. Ability to work in hazardous situations, i.e., risk of bodily injury	460200B013	3 2 1 N		
33. Think visually of geometric forms (S-spatial)	460200C001	3 2 1 N		
34. Comprehend the two dimensional representation of three-dimensional objects (S-spatial)	460200C002	3 2 1 N		
35. Recognize the relationship resulting from the movements of objects in space (S-spatial)	460200C003	3 2 1 N		
36. Perceive pertinent detail in objects in pictorial or graphic material (P-form perception)	460200C004	3 2 1 N		
37. Make visual comparisons and discriminations and see slight differences (P-form perception)	460200C005	3 2 1 N		
38. Coordinate eyes and hands or fingers rapidly and accurately (K-motor coordination)	460200C006	3 2 1 N		
39. Make a movement response accurately and swiftly (K-motor coordination)	460200C007	3 2 1 N		
40. Move the fingers and manipulate small objects with the fingers, rapidly or accurately (F-finger dexterity)	460200C008	3 2 1 N		

CARPENTRY
ACCESS SKILLS CHECKLIST

Student Name/ID ______________________ Sending School ______________________

Instructor ______________________ Date(s) Evaluated ______________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
1 = NOT MASTERED N or blank = NO EXPOSURE

TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE	DATE
41. Move the hands easily and skillfully (M-manual dexterity)	460200C009	3 2 1 N			
42. Work with the hands in placing and turning motions (M-manual dexterity)	460200C010	3 2 1 N			
43. Making generalizations, evaluations, or decisions based on measurable or verifiable criteria	460200D001	3 2 1 N			
44. Situations requiring the precise attainment of set limits, tolerances, or standards	460200D002	3 2 1 N			
45. Identify basic hand tools and equipment	460200E001	3 2 1 N			
46. Use basic hand tools and equipment	460200E002	3 2 1 N			
47. Demonstrate knowledge of basic safety concepts	460200E003	3 2 1 N			

CARPENTRY VOCABULARY LIST

ACOUSTIC	Having to do with sound or controlling sound.
APPLIANCE	Electricity-using devices.
ATTACH	To fasten.
BARE WIRE	Wire with no insulation covering the wire.
BLUEPRINT	A set of plans from which a structure is built.
BUNDLE	A number of asphalt shingles (26 or 27) wrapped together to ease handling and stacking (each bundle is 1/3 of a square).
CABLE	An insulated conductor of electricity that has at least two wires.
CIRCUIT	The path of electric current from the source to power user (i.e., lights) and back to the source.
CODE	A set of rules to protect people and buildings from the danger due to the use of electricity.
CONDUCT	Allow electric current to flow through.
CONDUCTORS	Materials that allow electrical current to pass through them.
CONDUIT	A pipe for carrying wires.
CURRENT	A movement of electricity in one direction, a flow.
DISCONNECT	To turn off power or take apart.
DRYWALL	Usually refers to a gypsum core board with a sheet of paper on either side. (Drywall is often called sheet-rock, plaster board, or gypsum board.)
FIXTURE	Electrical equipment fastened to a wall or ceiling.
FLEXIBLE	Bends easily.
FLUSH	Having surfaces in the same place; even or level.
FRAMED-UP	To build or construct framing.
FRAMING	Constructing walls, floors, and roof members of a structure.
GENERAL PURPOSE	For a variety of normal uses.

GROUND WIRE	The wire in a cable that carries no current which is used for safety.
HANG (HANGING)	To hang drywall means to permanently fasten it to its supporting structure (studs, joists, etc.).
INDIVIDUAL	Single.
INSTALL	To put in place for use.
INSULATE	To cover with a material that does not conduct electricity.
INSULATION	Material that does not carry current; used on the outside of wires.
JOIST	Horizontal beams used to support the floor or ceiling.
LAYOUT	To arrange or make according to a plan or blueprint.
LEVEL	A condition of being exactly horizontal.
LIVE WIRE	A wire that carries current.
MOUNT	To fix in place, to attach, to fasten.
MOUNTING SCREW	Screw designed to fasten one thing to another.
NORMALLY	Usually, almost always.
OCTAGONAL	Having eight sides.
OUTLET	A receptable where electricity can be taken out of the circuit.
OVERLOAD	Too much electricity for the wire; current demand exceeds that for which the circuit was designed.
PITCHED	Sloped or slanted downward.
PORCELAIN	A white fired and glazed type of clay.
POSITION	To put in place.
POWER SUPPLY CORD	A cable that has a 3-prong plug and a green grounding wire - used to bring power to an appliance from an outlet.
PRECAUTION	Care taken before you start.
RAFTER	Sloping roof member that rests on the walls and supports the roof structure.

RECEPTABLE	A place that receives the plugs; where you plug in appliances.
RECTANGULAR	Four sided figure.
REMOVE	To take out.
RIDGE	The highest horizontal line of the roof.
RIGID	Does not bend.
ROUGH	Not smooth or finished work.
SOURCE	Place where power begins or comes from.
SPECIFICATIONS	Size, dimension, kind, quality, and quantity of materials and workmanship needed for a construction job.
SQUARE	A condition where corners are exactly 90° and a structure fits together correctly; in roofing used to signify that a product will cover a 10' x 10' square or 100 square feet.
SQUARE FOOT	Area amount; length times width of a space.
STUD	Upright members in framework of a wall that supports the wall coverings and roof.
SUBFLOOR	A rigid material (plywood or particleboard) nailed to the floor joists to form a smooth, level surface for the finished floor covering.
SWITCH	A device used to turn the flow of electricity off and on.
TRACE	To follow.
UPRIGHT	Standing up, vertical.
UTILITY COMPANY	A company that produces and sells electricity or other community utility (telephone, gas, etc.).
VISIBLE	Part you can see.
WRENCH	Loosens or tightens a joint by biting into and holding onto a pipe as you turn it.
'	Symbol for feet (ft.).
"	Symbol for inches (in.).

TOOL LIST FOR CARPENTRY

- Adjustable wrench
- Anchor bolt
- Bench saw
- Bolts
- Brad
- Circular saw
- Claw hammer
- Combination square
- Diagonal cutter
- Drill
- Drill bits
- Files
- Framing square
- Hard hat
- Joist hangars
- Level
- Lumber
- Metal screws
- Miter square
- Nails
- Nail set
- Nail wood block
- Pliers
- Plumb bobs
- Portable drill
- Power cords
- Push-pull rule
- Radial arm saw
- Reciprocating saw
- Router
- Ruler
- Saber saw
- Safety glasses
- Saw horse
- Scaffold
- Screwdriver
- Shovel
- Spade
- Steel tape
- Step ladder
- Trowel
- Wallboard clips
- Wood screws
- Yardstick

CARPENTRY

Math Skills

Count two-place numbers
Add two-place numbers
Subtract two-place numbers
Perform standard units of measurement, i.e., cup, pint, quart, inch, foot, yard, ounce, pound
Use basic measuring instruments, i.e., rulers, scales
Multiply two-place numbers
Divide two-place numbers
Add common fractions
Subtract common fractions
Multiply common fractions
Divide common fractions
Add two-place decimals
Subtract two-place decimals
Multiply two-place decimals
Divide two-place decimals
Add surface areas, weights and measures
Subtract surface areas, weights and measures
Multiply surface areas, weights and measures
Divide surface areas, weights and measures

NOTE: Many math books and workbooks provide needed direction in learning basic operations in math. This section assumes that students have basic skills and is designed to be used in conjunction with any of the math books you might be using, or to establish your own supplemental units. Any math practice activities should be developed within the context of the vocational program. Other persons to use as resources in this area include: parents, math teacher, and industrial arts teacher.

1. Student will measure the length of a variety of items to 1/16 of an inch using a ruler and/or tape measure.

2. Using pieces of cardboard, student will square and cut with scissors squared materials using a framing square to check the accuracy of the cuts. The squares may be obtained from a shop teacher.

3. See instructional module on measurement. This module includes many activities to assist in developing measurement activities relating to building trades.

4. Given three pieces of wood of varying lengths, student will measure each one using length, width and depth measurements.

5. Student will count the number of sets of hinges in three rooms in the school building and add the number of sets together to reach a total number of sets. The student will then determine the number of single hinges there will be. The student will then determine how many screws will be needed to attach all the hinges.

6. Student will add several sets of problems involving feet and inches solving for an answer in feet and inches.

7. Given a specific room to measure, student will determine:
    a. floor area
    b. square feet
    c. perimeter

8. Given a blueprint, student will figure room areas and wall lengths. See Worksheet C #1.

9. Student will prepare mixture for paper mache models using ratios (2 parts water, 3 parts flour, 1 part white glue). Have student make a model.

10. Mix clay or sand mortar to build a small wall of dominoes or small wood pieces.

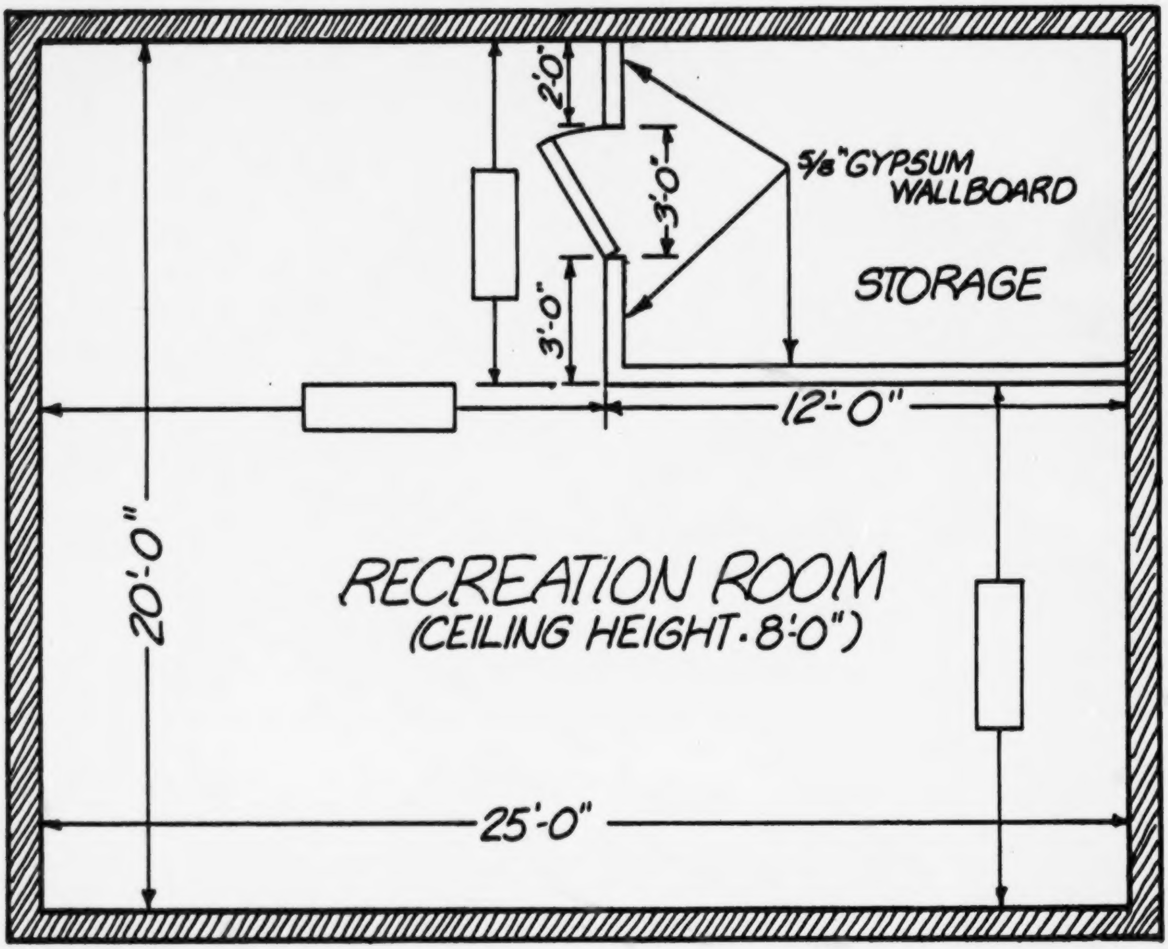
SUGGESTIONS FOR PARENTS:

1. Have student figure the square footage of his/her bedroom.

2. Have student make a blueprint of the floor in the home.

C #1

Worksheet


2'-0"
3'-0"
3'-0"
5/8" GYPSUM WALLBOARD
STORAGE
12'-0"
20'-0"
RECREATION ROOM
(CEILING HEIGHT - 8'-0")
25'-0"

BASEMENT RENOVATION SCALE $\frac{1}{4}$" = 1' PLAN

LEGEND	
▨	EXISTING 8" BLOCK
▭	NEW WALL

SPECIFICATIONS

1. NEW WALLS TO BE CONSTRUCTED WITH 2×4 STUDS, 16" O.C.
2. ALL EXISTING 8" BLOCK WALLS TO BE FURRED WITH 1×2, 12" O.C. RUNNING HORIZONTALLY.
3. ALL WALLS OF REC. ROOM TO BE SURFACED WITH $\frac{1}{4}$" PRE-FINISHED PANELS.

SOURCE: Math for the Carpenter, p. 5.

CARPENTRY

Physical Demands/Working Environment

Lift 50 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 25 lbs. (Medium work)
Ascend or descend, i.e., ladders, stairs, scaffolding, using the feet and legs and/or hands and arms (climbing)
Maintain body equilibrium to prevent falling when walking, standing, crouching or running (balancing)
Bend body downward and forward by bending the spine at the waist (stooping)
Bend legs at the knees to come to rest on the knee or knees (kneeling)
Bend body downward and forward by bending the legs and spine (crouching)
Move about on the hands and knees or hands and feet (crawling)
Extend the hands and arms in any direction (reaching)
Seize, hold, grasp, turn or otherwise work with the hand or hands (handling)
Pick, pinch, or otherwise work with the fingers (fingering)
Perceive size, shape, temperature or texture of objects and materials by using fingertips (feeling)
Ability to work both inside and outside
Ability to work in hazardous situations, i.e., risk of bodily injury

In most cases, the assessment of these skills will indicate that the student has the gross and fine motor skills which are prerequisites to learning the vocational skills in a Carpentry program. Prior to instruction in any physical demands activities, the student should have been evaluated and parents contacted to make sure that the student has no hidden physical problems that could be aggravated by lifting objects or by other physical activities done in this area. However, if the student has a physical disability or other limitation(s) preventing him/her from demonstrating fine and gross motor skills, then other techniques may be taught so he/she can perform in the vocational program. Other persons to use as resources in this area include: physical education teacher, industrial arts teacher, special education teacher, and parents.

1. Student will practice setting up and folding up a three foot ladder.

2. Student will practice climbing a three foot ladder. See physical demands module for more information on proper use of ladders. During the exercise two other students should be used to (1) hold the ladder, and (2) stand by the side of the ladder should the student need or desire assistance. If the student is unsure of himself/herself after five or six times up and down the ladder, careful consideration should be given to the vocation of carpentry.

3. Student will design a bulletin board of houses and house plans that are suitable for a middle income family in the student's area. The student will include the square footage cost to build each home on the display. Student will place the designs on the top of a bulletin board or area in the room that requires him/her to stand on something

to do the task. Using two boxes or one box and a three foot ladder and a plank 40" wide by 5-8' long, have student make a scaffolding Have student put display on the bulletin board using the scaffolding. Be sure another student stands behind student on the board while the display is being put into place.

4. Student will measure the wall space in a room on hands and knees. Student will then transfer the information to a sheet of drawing paper with 1/2 inch squares. Measuring room furniture student can make squares or rectangles representing each piece to size. Student can then develop three arrangements of furniture for the room. This activity involves physical demands and aptitudes.

5. Student will sort nails, nuts, bolts, and screws according to size and type. Provide student with a wide variety of these items in a tray and have student sort them according to size as well as shape. This may be difficult for some students at first. Give student one of each item and ask him/her to place the item in its own small container. The student may also wish to draw a pattern for each one to place in front of the container so student may lay the one they are sorting on the pattern to check accuracy. Be sure the student uses fingers to pick up each item one at a time. This activity involves both physical demands and aptitudes.

6. Student will saw two sections 1 1/2 feet in length from a 2' x 4' board using a regular wood saw. Student should be properly instructed in this process by either a shop teacher or a teacher who has received proper instruction. See Worksheet C #2.

7. Student will distinguish between a variety of building materials by texture and general feel. Provide student with a wide variety of building materials. Include the following: floor tiles, metal plate coverings, linoleum, wood squares, dowls, rough wood, knotted wood, etc. Have student list as many descriptive words on the shape or feel of each piece of material. A game using the materials could go as follows: Have students sit in a circle. First student states what he/she has and then gives one descriptive word for the item, passes it to the next student who does the same, uses the first student's word and adds one, then passes it on. The student who can remember all the words and find a new one last wins that point. The students can also use what the material might be used to build in order to give them a wider range of choices.

8. Given the opportunity to view carpenters at work, student will identify ways in which the carpenter uses his/her body for reaching, bending, stooping, kneeling, reaching, etc.

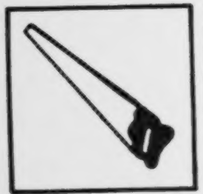
9. Several instructional modules may be found at the end of the Trade and Technical program areas. The module "Identification and Use of Tools" is recommended for additional activities in this and other areas of carpentry.

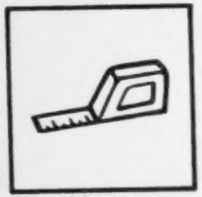
SUGGESTIONS FOR PARENTS:

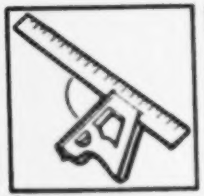
1. Have student make a box with small compartments for small items such as nuts, bolts, etc. and label each section.
2. When working with student or spending time together ask student to describe texture of objects in the area.
3. Provide student with opportunity to climb ladders and do other phsycial labors requiring stooping, reaching, etc.

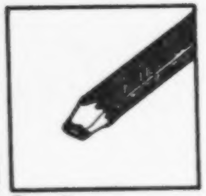
Cutting and Measuring Materials

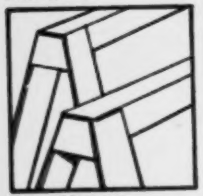
1. Assemble the following tools and materials.

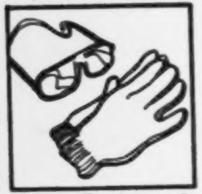

Hand Saw

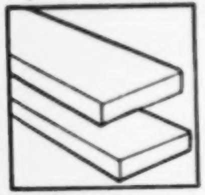

Tape Measure


Square

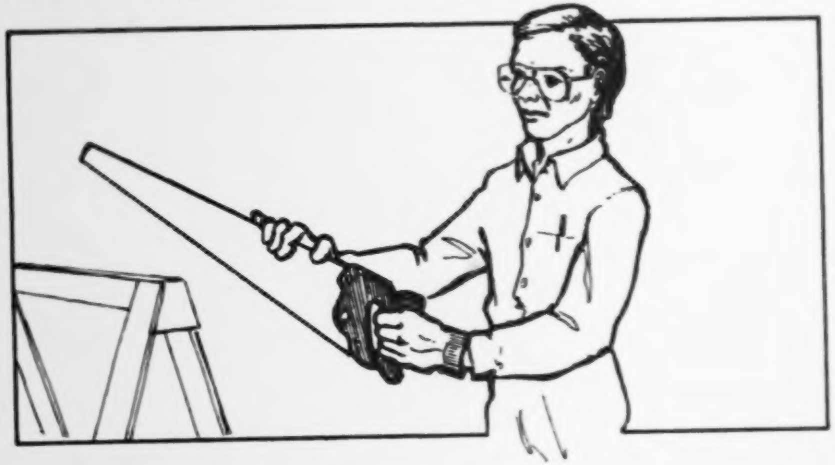

Pencil


Saw Horses


Safety Equipment

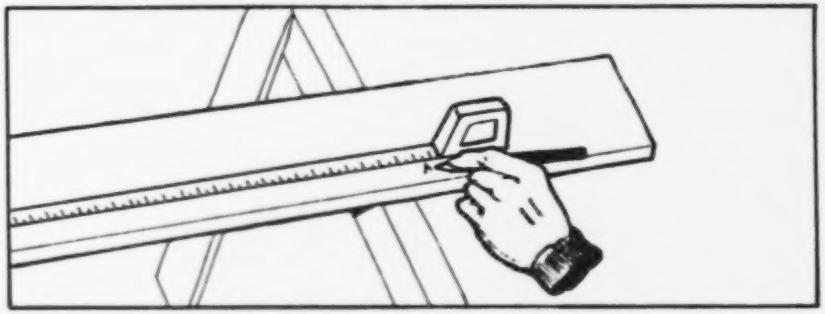

Lumber

2. Put on safety glasses and gloves and get hand saw.

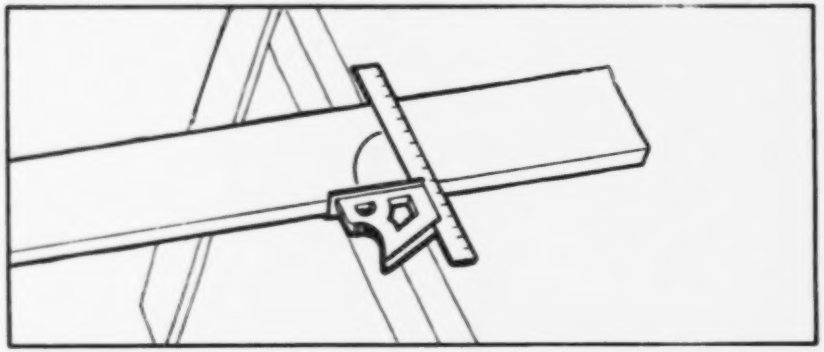


3. Place lumber on saw horses.

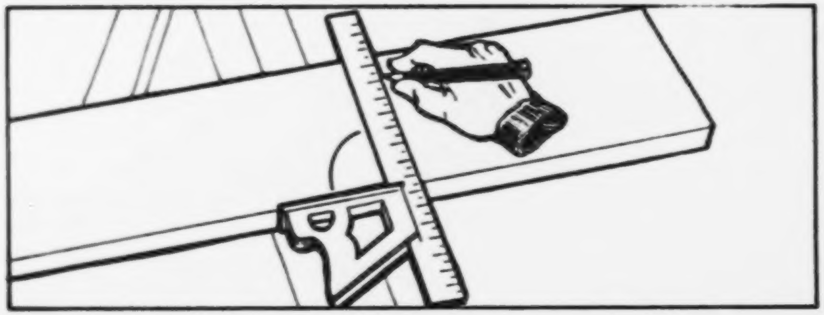
4. Measure the length to be cut and mark it with the pencil.



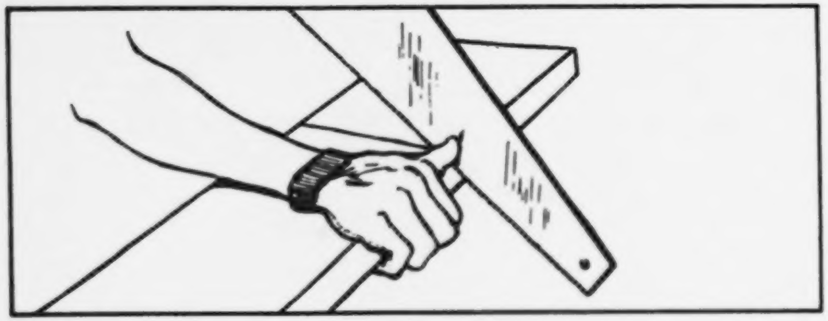
5. Place the square against the front edge of the board and across the top.



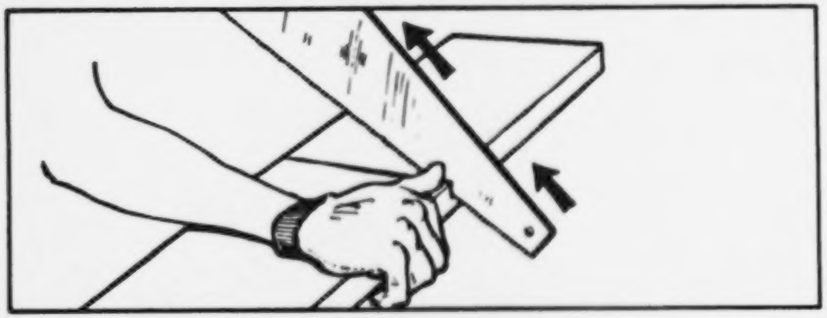
6. With the pencil, mark a squared line across the lumber at the specified length.



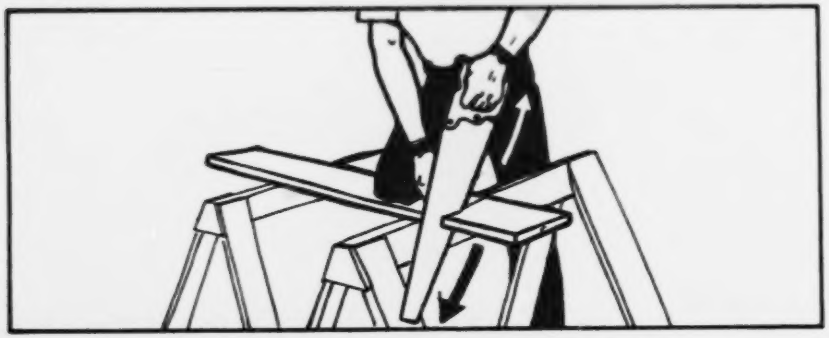
7. Place the blade of the hand saw on the cutting mark. Place your thumb against the side of the saw blade for support.



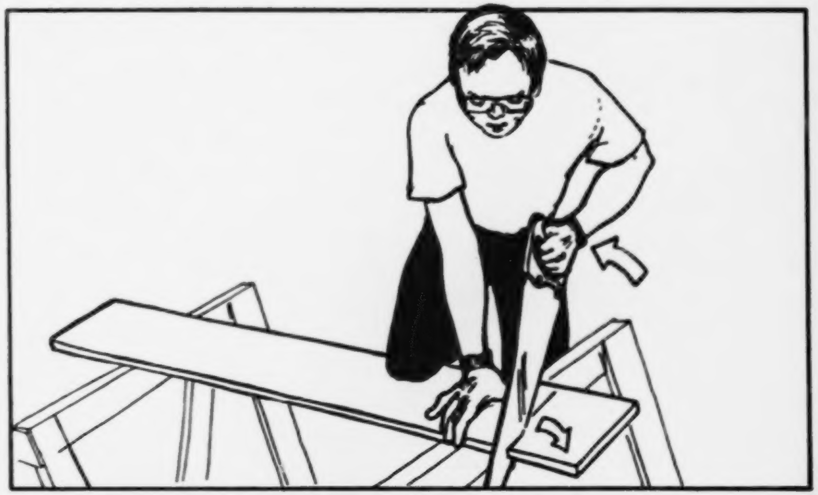
8. Pull the saw back slowly to begin the cut.



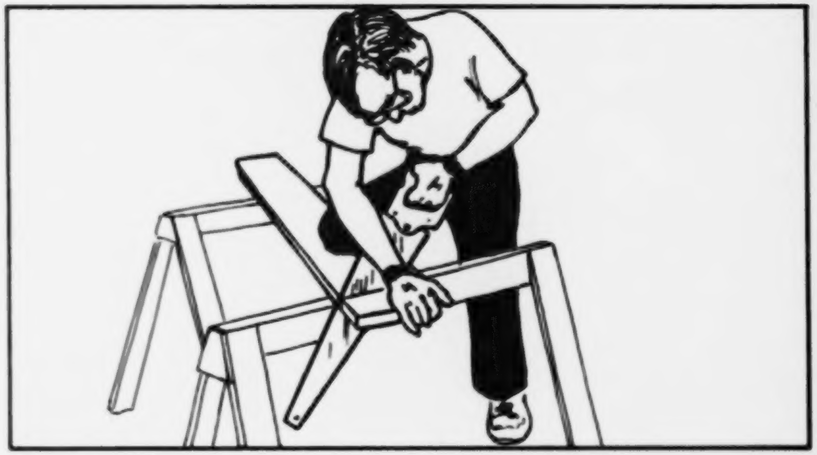
9. Use long, smooth forward and backward strokes to cut. Follow the pencil line.



10. Use a twisting motion to bring the saw back to the cutting line if it starts to wander.



11. Use your hand to support the end being cut.



12. As you approach the end of the cut, shorten the length of the stroke.

CARPENTRY

Aptitudes - indicates an ability to:

think visually of geometric forms (S-spatial)
comprehend the two-dimensional representation of three-dimensional objects (S-spatial)
recognize the relationship resulting from the movements of objects in space (S-spatial)
perceive pertinent detail in objects in pictorial or graphic material (P-form perception)
make visual comparisons and discriminations and see slight differences (P-form perception)
coordinate eyes and hands or fingers rapidly and accurately (K-motor coordination)
make a movement response accurately and swiftly (K-motor coordination)
move the fingers and manipulate small objects with the fingers, rapidly or accurately (F-finger dexterity)
move the hands easily and skillfully (M-manual dexterity)
work with the hands in placing and turning motions (M-manual dexterity)

1. Student will hammer nails into the 1 1/2 foot board cut previously. Hammering nails can be a painful experience. Student should be taught the proper techniques for this activity. Some students may prefer to wear a work glove on the hand holding the nail until they feel more comfortable with their aim. A large nail should be used during the learning stage. Smaller nails in varying sizes may then be used.

2. When students are comfortable with hammering and/or sawing, a variety of relay games may be constructed providing for additional use of these skills. Teams can compete in pounding nails into boards. For example, each member on a team must pound one nail into the board. They must do this one after the other. Or a team must pound four nails into a board. Each person has three strikes (hit or miss). The team with the least strikes at the nails wins. A relay combining sawing and hammering would provide good skill practice and a lot of fun.

3. Given a tool box and tools, student will arrange tools in the box for ease of access and according to tool use.

4. Given a common nail, finish nail, roofing nail, carriage bolt and nut, flat head phillips screw, and round head single slot screw, student will identify each by name and use. See Worksheet C #3.

5. Given a sample of floor coverings, student will identify the items and their probable area of use. See Worksheet C #4.

6. Given a picture of various exterior sidings, student will identify each one. See Worksheet C #5.

7. Given the opportunity to view a variety of homes in a neighborhood, student will identify types of exterior house coverings.

SUGGESTIONS FOR PARENTS:

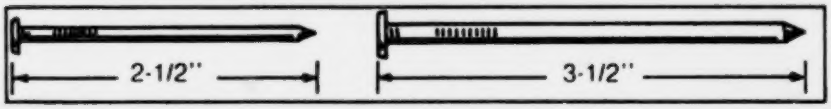
1. Have student arrange tools in home in a workshop setting or in a box.
2. Have student identify the types of exterior and interior wall and sidings used in various parts of the home

Identify Common Fastening Devices

Nails

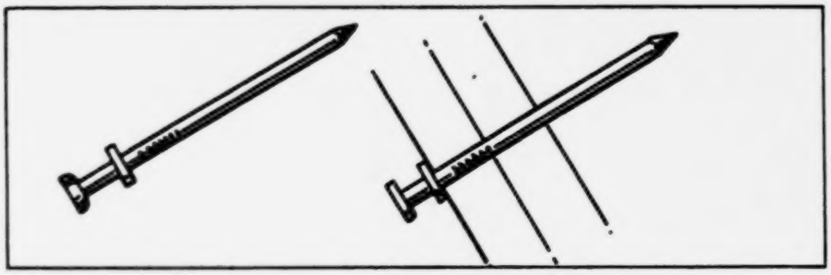
A carpenter works with many types of fastening devices. The most common are nails. Nails are made in many different types, sizes, and coatings. They are sold by the pound or in fifty pound boxes. Nails that are generally used in rough framing of floors and walls are called common nails. Some of the most familiar common nails are:

6^d (2" long) used for ½" material, an all-purpose nail
8^d (2½" long) used for ¾" material
10^d (3" long) used for 1" material
16^d (3½" long) used for 1½" material

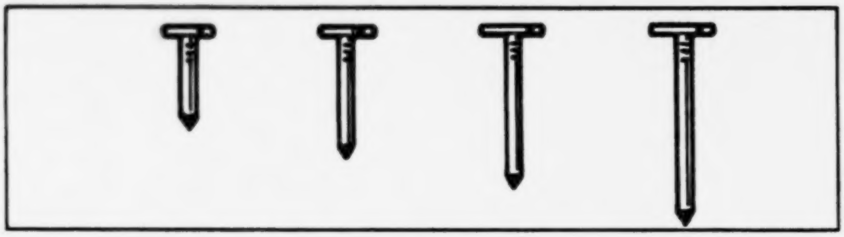


NOTE:
The "d" is pronounced as penny, for instance, an 8penny nail.

Double-headed nails (called scaffold nails) are used for work that will be taken apart, such as temporary braces, forms, and batterboards. When the nail is driven, the first head secures the work and the second head protrudes above the surface for easy removal later.



Roofing nails are coated with zinc to prevent rusting. They have large heads that hold the shingles better. They are sold in desired lengths such as: ¾, 1, 1¼, 1½, 1¾, and 2" lengths.

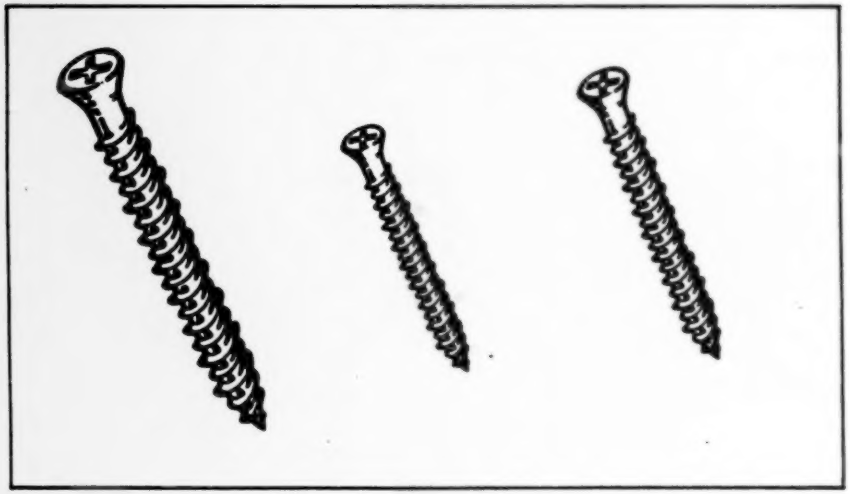


Finish nails have small heads. They are generally used for trim and are meant to be set below the surface of the material.

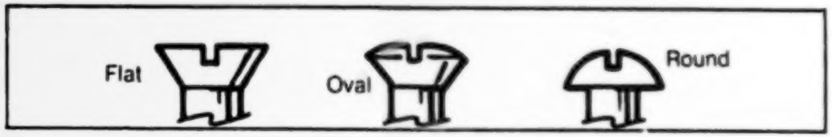
Screws

Screws are sold by the hundreds. They are measured with the numbers 3 through 16. The larger the number, the bigger the diameter. They are also sold by their length.

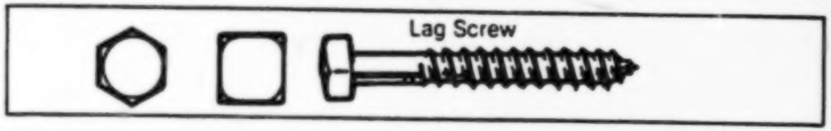
There are other types of screw which are usually used in industry.



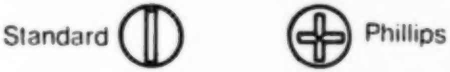
Screws also have different shapes of heads. Round heads are used where the head will be seen. Flat heads are used and countersunk with the head flush with or below the surface. Oval heads are used where the head is seen but also countersunk. And panhead screws are used on sheet metal or soft wood.



Lag screws are generally larger and are put in with a wrench. They are used where a large amount of holding power is needed.



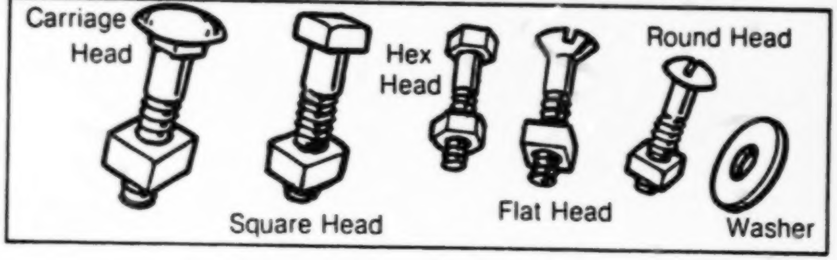
Most screws have either a single slot (standard) or a Phillips head. There are other types of screws though, usually used in industry.



Bolts

Bolts also come in various sizes, shapes and lengths. They are purchased in boxes of fifty or one hundred. Bolts are sold by the diameter and the pitch (number of threads per inch) of the thread. For instance, ¼"-20 means ¼" in diameter and 20 threads per inch.

Bolts have different types of heads such as square heads, round heads, and flat heads. A bolt is used with a nut and washer.



SOURCE: Building Trades, IML.

Worksheet C #4

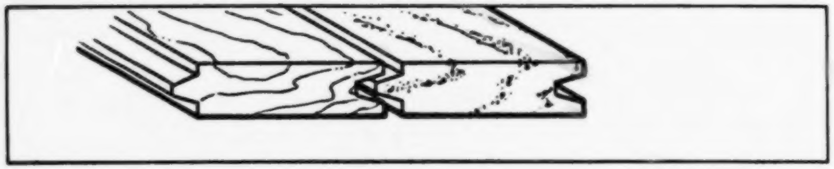
Identifying Common Interior Coverings

Interior coverings are the coverings for walls, ceilings, and floors inside a structure. Each group has many different types of materials with hundreds or even thousands of styles within each type.

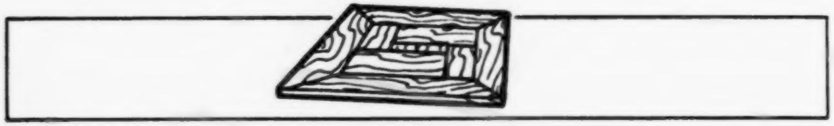
Floor Coverings

Floor coverings are picked for their cost, ease of installation and maintenance, durability, and looks. Wooden floors are still very popular in homes and come in three main types: hardwood, softwood, and sheet flooring.

Hardwood flooring is usually oak. It is tongue and grooved strip flooring that is nailed to the subfloor. Hardwood flooring comes in different widths and lengths.

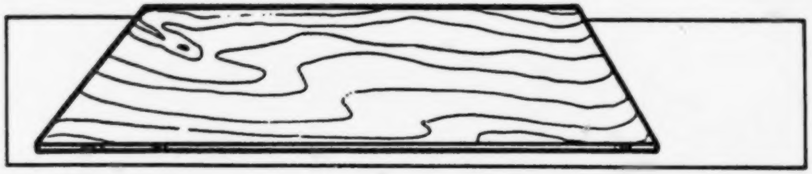


A specialized type of hardwood flooring that comes in a "tile" form is called parquet ("par-kay") flooring. Parquet is several small pieces of hardwood laid out in a pattern.

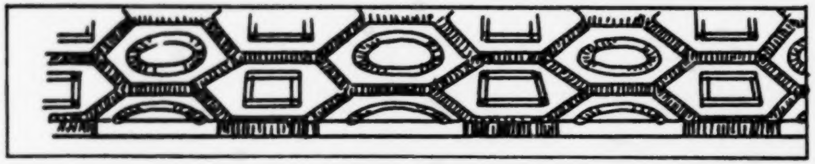


Softwood flooring is usually made of pine. It also is tongue-and-grooved strip flooring that comes in different lengths and widths. Besides natural finishes, softwood is often stained or painted.

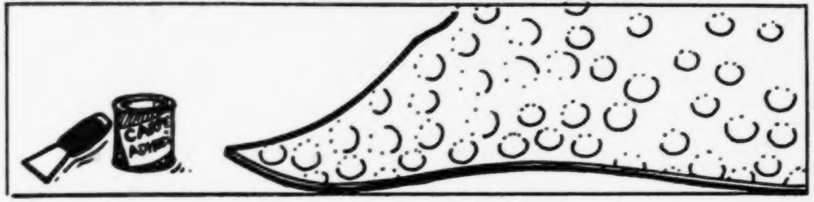
Wooden sheet flooring comes in 4'x 8' sheets and is often used as subflooring as well as finished flooring. Sheet flooring can be stained, painted, or have a natural top coat. The most often used wooden sheet floorings are plywood, chipboard, hardboard, and particleboard.



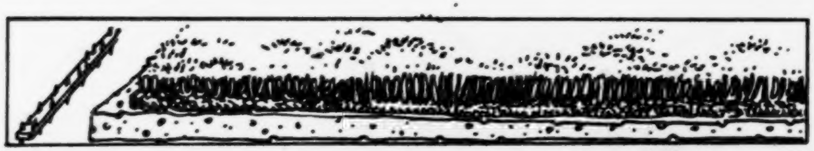
Another popular type of flooring is the hard surface type. Ceramic tile, quarry tile, mosaic, brick, terrazo, marble, stone, and slate coverings are glued to the subfloor and have the space between each piece grouted.



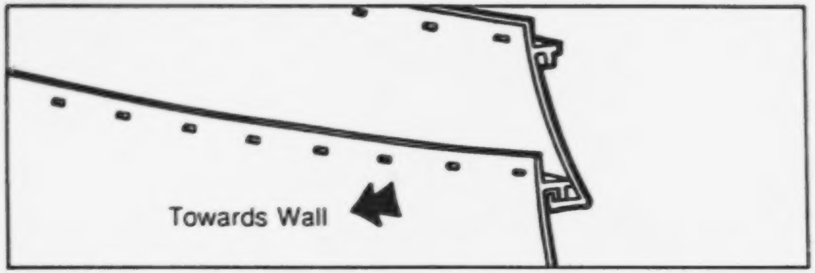
Soft flooring consists of cork, linoleum, rubber, thermoplastic, and vinyl. These types of coverings come in large sheets or tile-like squares and are glued to the subfloor.



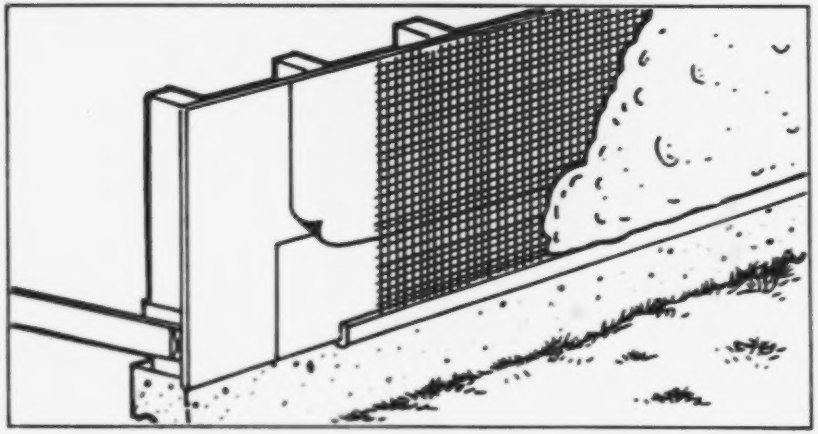
Carpeting is used extensively as a floor covering. Carpets can be classified by material (natural or synthetic fibers), pile (cut, looped, or cut-looped), application (indoor-outdoor or home-industrial), and color.



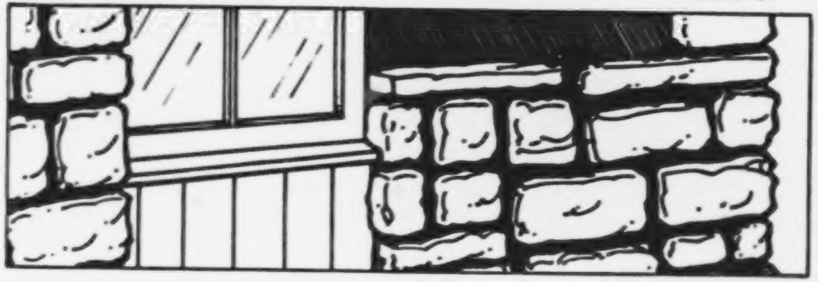
Plastic or Vinyl Siding
Vinyl siding is similar to metal siding. An advantage of vinyl is that the color is the material itself and not a coating so it never needs finishing.



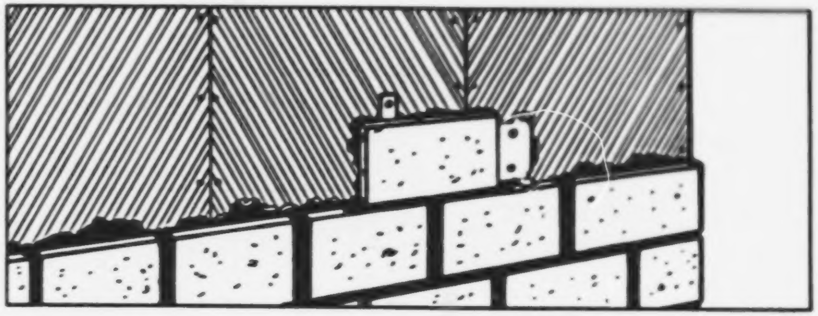
Stucco
Stucco is a special type of exterior plaster that is applied over a screened metal mesh (wire lath).



Stone
Stone is usually applied as a veneer over the standard sheathing of a structure. The stone is held to the sheathing with metal ties in the joints that have been screwed or nailed to the wall structure.



Brick Siding
Most modern brick homes are actually a single width of brick veneer laid outside the standard stud and sheathing framework. There are several types of brick veneers manufactured that are nailed or glued to the sheathing and mortared layer to simulate a common brick wall.

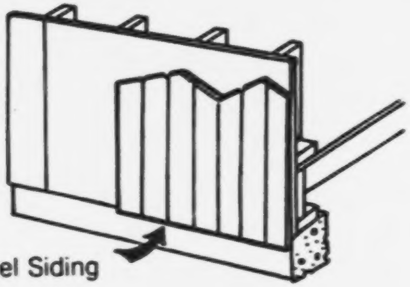


Exterior Wall Coverings

Exterior wall coverings are picked for cost, ease of installation and maintenance, durability, and appearance.

Several types of siding are common: sheet, board, shingle, woodlap, metal, vinyl, stucco, brick, and stone.

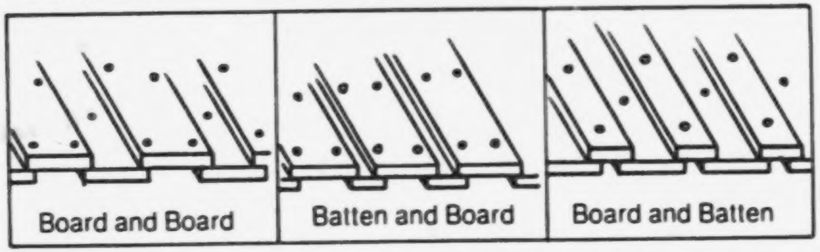
Sheet siding is usually 5/8" thick and comes in 2 or 4 foot widths of 8 or 9 foot lengths. Often, sheet siding has some form of texture (rough, stucco, etc.) and a grooving (usually vertical). Most sheet siding is made of redwood, pine, fir, cedar, or hardboard.



Exterior
Plywood Panel Siding

Board Siding

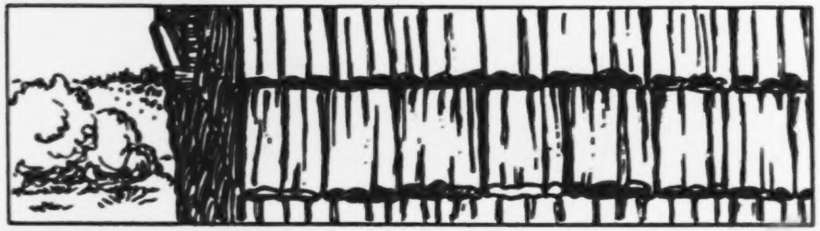
Board siding is mainly made of redwood, cedar, pine, or fir. Usually it is a vertical siding of dimensional lumber with special joints or bevels. Three common types of board siding are: board and batten, batten and board, and board and board.



SOURCE: Building Trades, IML.

Shingles

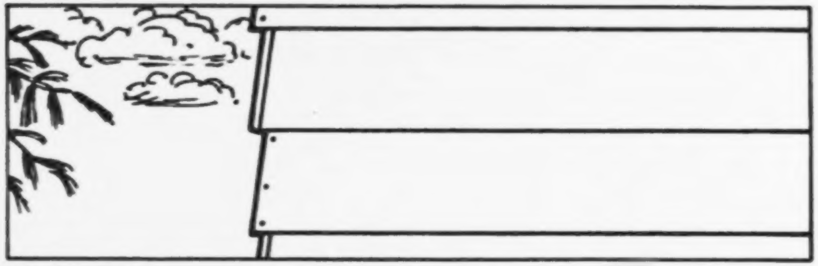
Wall shingles are usually made of cedar. They can be cut to produce decorative patterns.



Lap Siding

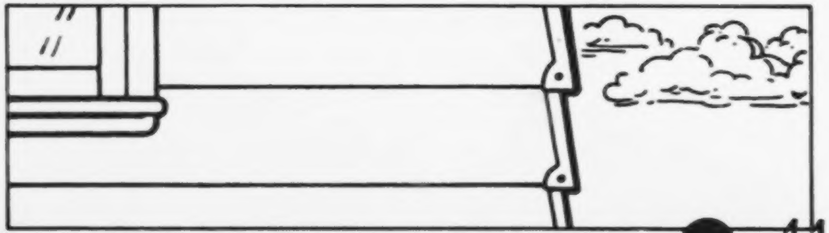
Lap siding is horizontal planking that is over-lapped to produce a weather-proof wall. Rain, for example, will run down the wall but will not come inside because of how the wall is lapped.

Lap siding can be made of wood, metal, or vinyl and comes in 8', 10', 12', 14', 16', and 18-foot lengths and 4", 6", 10", and 12-inch widths. There are several different joint types of lap siding.



Metal Siding

Metal siding is made of steel or aluminum. Most metal siding is aluminum and comes prefinished with a baked-on enamel. This type of siding is often textured to look like wood grain and has a 3/8 inch rigid foam backing for insulation. The edges of metal siding interlock the color is in the material itself and not a coating so it never needs painting.



CARPENTRY

Temperament - indicates an ability to adapt to:

making generalizations, evaluations, or decisions based on measurable or verifiable criteria
situations requiring the precise attainment of set limits, tolerances, or standards

1. Given several sets of materials that are used together, student will pair sets and explain reason for choices. For example, hammer and nail, screwdriver and screw.
2. Give an assignment, student will list materials to be gathered for the task and explain choices.
3. Given a floor plan, student will trace the plan and color in each room with a different color.
4. Given a list of materials for a building project, student will collect materials exactly as listed.
5. Given an assignment by teacher, student will take three changes of instructions in a positive manner.

SUGGESTIONS FOR PARENTS:

1. Give student a shopping list which includes brand names and weights and have student collect materials and check when back from store.
2. Purchase a model of some type and have student put model together following a specific timeline schedule. Do not allow student to finish early or late.

CARPENTRY

Vocational

Demonstrate knowledge of basic safety concepts
Identify basic hand tools and equipment
Use basic hand tools and equipment

1. Student will complete instructional module on basic safety and first aid
2. Student will complete module on identification and use of basic hand tools.

SUGGESTIONS FOR PARENTS:

1. Have student identify safety hazards that may exist in the home.
2. Have student put together a first aid kit for the home.
3. Have student identify tools in home and make a list of basic tools that are not available and assist parent in purchasing them as it is possible.

RESOURCES

CARPENTRY

American Technical Publishers, Inc.
1155 W. 175th St.
Homewood, IL 60430

Basic Blueprint Reading - Residential, Putnam, R.

Center for Occupational Curriculum Development
Continuing Education
E.I.M.C.
P.O. Box 7218
University of Texas-Austin
Austin, TX 78713

Carpenter - Volume 1, Instructor's Guide

Delmar Publishers, Inc.
2 Computer Drive West
Box 15-015
Albany, NY 12212

Practical Problems in Mathematics for Carpenters, Huth, H. C.

Goodheart-Wilcox Company, Inc.
123 W. Taft
South Holland, IL 60473

Modern Carpentry, Wagner, W. H.
Workbook for Modern Carpentry, Wagner W. H.

Instructional Materials Laboratory
908 Woodson Way
University of Missouri-Columbia
Columbia, MO 65211

Instructor's Guide: Building Trades, Volume 1
Vocational Preparation Curriculum - Carpentry, Herd, A.

Motivation Development, Inc.
P.O. Box 427
Bishop, CA 93514

Carpentry Math, Wiltsie, D.

COMMERCIAL ART

Sample Occupational Areas:
Artist, Woodblock
Fashion Artist
Illustrator
Photographer Helper

Introduction

The field of commercial art provides work for individuals who like to draw. The types of drawing required vary from designing advertisements for large companies to labels on soup cans. The commercial artists must be able to bring someone else's ideas into visual reality. They draw from their own imagination, they copy and/or trace, they work in a hurry and with a large variety of materials. Because the commercial artist usually draws for others, he/she must be willing to accept the criticism and rejection of ideas in the context of the reason it is given. The commercial artist works indoors and for extended periods of time and frequently under pressure. Individuals who work in this field thrive on the need for constant drawing, the challenge of meeting others' demands and the long hours. The rewards of the finished product are worth the effort to produce it.

NOTE: The VIMS competency list has not yet been completed for Commercial Art. Contact your area school instructor in this area to obtain the list of skills students will learn.

COMMERCIAL ART
ACCESS SKILLS CHECKLIST

Student Name/ID ______________________ Sending School ______________________

Instructor ______________________ Date(s) Evaluated ______________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
1 = NOT MASTERED N or blank = NO EXPOSURE

TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
1. Count two-place numbers	480298A001	3 2 1 N		
2. Add two-place numbers	480298A002	3 2 1 N		
3. Subtract two-place numbers	480298A003	3 2 1 N		
4. Perform standard units of measurement, i.e., cup, pint, quart, inch, foot, yard, ounce, pound	480298A004	3 2 1 N		
5. Use basic measuring instruments, i.e., rulers, scales	480298A005	3 2 1 N		
6. Multiply two-place numbers	480298A006	3 2 1 N		
7. Divide two-place numbers	480298A007	3 2 1 N		
8. Add common fractions	480298A008	3 2 1 N		
9. Subtract common fractions	480298A009	3 2 1 N		
10. Multiply common fractions	480298A010	3 2 1 N		
11. Divide common fractions	480298A011	3 2 1 N		
12. Add two-place decimals	480298A012	3 2 1 N		
13. Subtract two-place decimals	480298A013	3 2 1 N		
14. Multiply two-place decimals	480298A014	3 2 1 N		
15. Divide two-place decimals	480298A015	3 2 1 N		
16. Lift 10 lbs. maximum with occasional lifting and/or carrying of small articles, i.e., tools, ledgers (sedentary work)	480298B001	3 2 1 N		
17. Extend the hand and arms in any direction (reaching)	480298B002	3 2 1 N		
18. Seize, hold, grasp, turn or otherwise work with the hand or hands (handling)	480298B003	3 2 1 N		
19. Pick, pinch, or otherwise work with the fingers (fingering)	480298B004	3 2 1 N		
20. Perceive size, shape, temperature or texture of objects and materials by using fingertips (feeling)	480298B005	3 2 1 N		
21. Ability to work inside	480298B006	3 2 1 N		
22. Think visually of geometric forms (S-spatial)	480298C001	3 2 1 N		
23. Comprehend the two dimensional representation of three-dimensional objects (S-spatial)	480298C002	3 2 1 N		

COMMERCIAL ART
ACCESS SKILLS CHECKLIST

Student Name/ID ______________________ Sending School ______________________

Instructor ______________________ Date(s) Evaluated ______________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
1 = NOT MASTERED N or blank = NO EXPOSURE

TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
24. Recognize the relationship resulting from the movements of objects in space (S-spatial)	480298C003	3 2 1 N	________	________
25. Perceive pertinent detail in objects in pictorial or graphic material (P-form perception)	480298C004	3 2 1 N	________	________
26. Make visual comparisons and discriminations and see slight differences (P-form perception)	480290C005	3 2 1 N	________	________
27. Perceive pertinent detail in written or tabular materials (Q-clerical perception)	480298C006	3 2 1 N	________	________
28. Move the hands easily and skillfully (M-manual dexterity)	480298C007	3 2 1 N	________	________
29. Work with the hands in placing and turning motions (M-manual dexterity)	480298C008	3 2 1 N	________	________
30. Match or discriminate between colors	480298C009	3 2 1 N	________	________
31. Identify a particular color or color combination	480298C010	3 2 1 N	________	________
32. Perceive contrasting color combinations	480298C011	3 2 1 N	________	________
33. Making generalizations, evaluations, or decisions based on sensory or judgmental criteria	480298D001	3 2 1 N	________	________
34. Demonstrate knowledge of basic safety concepts	480298E001	3 2 1 N	________	________

COMMERCIAL ART VOCABULARY LIST

ACETATE	a cellulose sheet of paper that is clear or colored and produces a variety of artistic effects
AIRBRUSH	an atomizer using compressed air to spray paint or other liquids on a surface
ANIMATION	a drawing made or designed so as to seem alive and moving
BALANCE	a harmonious or satisfying arrangement or proportion of parts or elements, as in a design
BINDING	a substance that holds two materials together such as rubber cement
BOLDFACE	printing in extra heavy lines and ink so it stands out from the rest of the text
BURNISH	a smooth, glossy finish or appearance
CHARACTER	a symbol or mark used in a writing system
CHART	a sheet presenting information in the form of graphics
CIRCULAR	lines, drawings or forms that are round in nature
COLUMN	one of two or more vertical sections of typed lines lying side by side on a page separated by white space
COMMERCIAL	involved in work that is intended for the mass market
CONDENSED	to become more compact
CONTRAST	the use of opposing elements, such as colors, forms or lines, in proximity to produce an intensified effect in a work of art
CROP	to cut down in size
DEADLINE	a final time for something to be completed
DENSITY	opaque with good contrast between light and dark areas
DUOTONE	two shades of colors comprising a drawing or pieces of artwork
ETCH	to cut into the surface of a material using acid
EYEBALL	to informally look over something carefully

FIXATIVE	a liquid preservative applied to artwork such as watercoler or charcoal drawings to keep them from smearing or running
HIGHLIGHT	a light or brilliantly lighted area of a painting, to make an emphasis
ILLUSTRATION	visual matter used to clarify or to decorate a text
IMAGE	an optical reproduction of an object formed by a lens or mirror
IMPRESSION	the effect, mark, or imprint made on a surface by pressure
INDENTION	to make notches, grooves, or holes in material
LAMINATE	to cover with thin sheets
LAYOUT	a dummy sketch or paste-up for matter to be printed
LETTERING	the act, process, or art of forming letters
LOGO	the name, symbol or trademark of a company or publication borne on one printing plate or piece of type
LOWER CASE	small letters, no capitals
MOUNTING	to place or fix on or in a secure place for display, study or use
PROOFREAD	to read copy or print against the original manuscript for corrections
REPRODUCTION	to make copies of an original
THUMBNAIL	brief in size
TRANSPARENT	something so clear or fine in substance that it can be seen through
UPPER CASE	capital letters of the alphabet

TOOLS AND EQUIPMENT FOR COMMERCIAL ART

Basic Items (considered to be commonly available and may not be specifically itemized).

Tools

Brushes, pointed

Holder, pen

Pens

Instrument, drafting set, including ruling pen

Triangle, 30-60-90

Triangle, 45-45-90

Knife, X-Acto, mat

French curve

Scale, fraction

Scale, decimal (engineer, triangular)

Scissors

Sharpening stone

T-square, straight edge

Pencil pointer

Can, rubber cement with brush and thinner

Water jars

Equipment

Table, drawing

Taboret

Light, desk (optional)

Drafting (arm) machine

Cutter, paper

Table, light

Illumination, adequate room

Filing cabinet

Materials

Ink, black india

Paper, bond, newsprint

Paper, graphite

Paper, tracing

Pencils, graphite drafting, carbon

Eraser, pearl, kneadable, soap

Acetate, clear and colored

Sand paper

Tape, scotch masking

Tape, scotch magic

White opaque watercolor

Board, illustration

Board, Bristol

Board, Ross

Fixative

Pastels

COMMERCIAL ART

Math Skills

Count two-place numbers
Add two-place numbers
Subtract two-place numbers
Perform standard units of measurement
  i.e. cup, pint, quart, inch, foot,
  yard, ounce, pound, etc.
Use basic measuring instruments,
  i.e., rulers, scales
Multiply two-place numbers
Divide two-place numbers
Add common fractions
Subtract common fractions
Multiply common fractions
Divide common fractions
Add two-place decimals
Subtract two-place decimals
Multiply two-place decimals
Divide two-place decimals

NOTE: Many math books and workbooks provide needed direction in learning basic operations in math. This section assumes that students have basic skills and is designed to be used in conjunction with any of the math books you might be using, or to establish your own supplemental units. Any math practice activities should be developed within the context of the vocational program. Other persons to use as resources in this area include: parents, math teacher, and industrial arts teacher.

1. Using a ruler, student will measure height of letters of varying sizes used in classroom texts. Student can record how many different sizes there are and what the height range is.

2. Student will select 3 illustrations of varying size and measure spaces for these pictures to be placed on an 8 x 11 or 11 x 17 sheet of paper in an attractive display.

3. Student will establish a time management system. Have student keep track of daily activities and how much time is spent on each activity. Then have student section off parts of each day for a one week period to accomplish specific tasks. This is important when managing time allotments for commercial art jobs.

4. Student will keep track of time spent on specific jobs by clocking on and off the job. Assign student a project that might take 5 to 7 hours to complete. Have the student sign a time sheet each time he/she begins and ends work on the project. At the completion of the project have the student total the amount of time spent. Then have the student tabulate what they would have earned if they were paid a varying amount of money by the hour. The project might be one that would coincide with an aptitude activity. For example, the student might be asked to design and draw flat and 3-dimensional illustrations of a bulletin board. They must do all the artwork, including the lettering. They will need to submit the plans and illustrations to the teacher for approval. The student should be advised to count time spent in consulting with client (teacher).

SUGGESTIONS FOR PARENTS:

1. Have the student keep track of time spent on leisure and work activities and determine what percent of home time falls into each category.

COMMERCIAL ART

Physical Demands/Working Environment

Lift 10 lbs. maximum and occasionally lifting and/or carrying small articles, i.e., tools, ledgers (sedentary work)
Extend the hands and arms in any direction (reaching)
Seize, hold, grasp, turn or otherwise work with the hand or hands (handling)
Pick, pinch, or otherwise work with the fingers (fingering)
Perceive size, shape, temperature or texture of objects and materials by using fingertips (feeling)
Ability to work inside

In most cases, the assessment of these skills will indicate that the student has the gross and fine motor skills which are prerequisites to learning the vocational skills in a Commercial Art program. Prior to instruction in any physical demands activities, the student should have been evaluated and parents contacted to make sure that the student has no hidden physical problems that could be aggravated by lifting objects or by other physical activities done in this area. However, if the student has a physical disability or other limitation(s) preventing him/her from demonstrating fine and gross motor skills, then other techniques may be taught so he/she can perform in the vocational program. Other persons to use as resources in this area include: physical education teacher, industrial arts teacher, art teacher, special education teacher, and parents.

1. Student will use proper lifting techniques. A short instructional module on physical demand movements is located at the end of this manual.

2. Student will sit at a drawing table and determine how much and what type of reaching is done while working on an art project.

3. Student will observe students in an art class noting the type of reaching performed as the students work on their projects.

4. Using press-on letters and/or dry-transfer letters, student will make signs or labels as directed by the teacher. The guidelines for using dry-transfer letters is as follows:

    a. Draw a light or blue pencil guideline.
    b. Position letter over the guideline.
    c. Rub gently over the letter with a ball point pen, pencil or similar object.
    d. When completed, rub the message with the backing sheet.

5. Student will sketch (trace) around a picture of a single object shown through an opaque projector. See worksheet CA #1.

6. Student will find or draw 3 pictures of a single object. They will use a variety of textured materials that represent the feeling the object is trying to project. For example, a chair may use leather, fake fur, or chintz.

7. Student will determine in which environment he/she prefers to spend majority of his/her time.

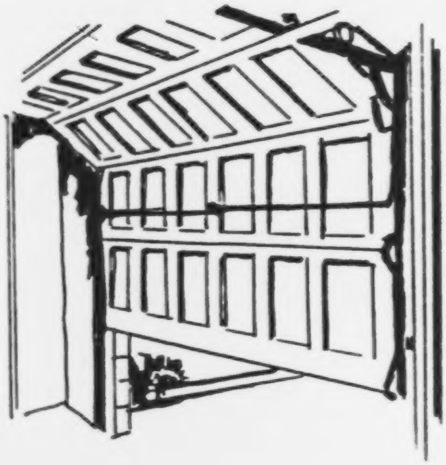
SUGGESTIONS FOR PARENTS:

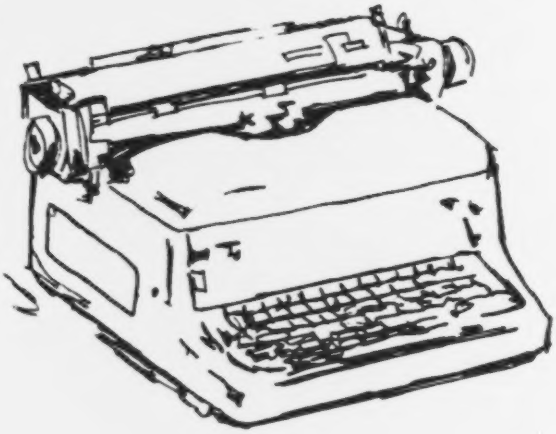
1. Have student identify the types of fabrics, by texture, used in his/her bedroom and the family or living room. Have him/her determine what types are used most in the two types of rooms.

2. Have student list the types of jobs he/she enjoys doing around the home. Assist student in determining preference for indoor and/or outdoor work.

WORKSHEET

Place this page in an opaque projector. Then project the image of one of the items on your drawing surface. Sketch with pencil around the contours of the object. Finish the drawing in india ink. You may like to add more shading to the objects.





COMMERCIAL ART

Aptitudes - indicates an ability to:

think visually of geometric forms (S-spatial)
comprehend the two dimensional representation of three-dimensional objects (S-spatial)
recognize the relationship resulting from the movements of objects in space (S-spatial)
perceive pertinent detail in objects in pictorial or graphic material (P-form perception)
make visual comparisons and discriminations and see slight differences (P-form perception)
perceive pertinent detail in verbal or tabular materials (Q-clerical perception)
move the hands easily and skillfully (M-manual dexterity)
work with the hands in placing and turning motions (M-manual dexterity)
match or discriminate between colors
identify a particular color or color combination
perceive contrasting color combinations

1. Given a square, rectangle, triangle, and circle, the student will draw each in 3-dimensional perspective.

2. Student will select 5 types of items they like to draw (e.g., a thing, an animal, portrait, scenery, etc.) and make 2 or 3 sketches of each one in flat drawing, and 2 to 3 in 3-dimensional. Student will select the one they like best from each of the 5 areas. Then select the one they like best of all the 5 final drawings.

3. Student will design a logo or drawing representing an activity or product of their choosing. The drawing or logo will appear on the side of a paper bag.

4. Given a selection of pictures to copy, student will copy the one they prefer in as perfect detail replicating the picture as they possibly can. Student will ask 3 classmates to evaluate the exactness of the drawing compared to the original. Student must also evaluate the drawing in the same manner.

5. Student will draw cartoons based on jokes, classroom situations or pertinent ideas given to him/her by classmate. Student should keep track of time spent on the cartoons developed and estimate how much money might be earned if the current minimum wage were in effect.

6. Student will design a layout to advertise a school activity. The first should be rendered as a thumbnail sketch, the second sketch should be a blown up version including changes.

7. Student will make a sign using only lettering. The project should have the student first rough in the lines and letters using a ruler as

necessary, check the spelling of the words, determine that letters are the correct size and then fill in letters.

8. Student will draw a finished product based on a blue print design.

9. Student will draw charts and graphs based on classroom research. Teacher may wish to conduct some fun classroom research, e.g., how much time students spend on homework during school days compared to weekends, the student could then draw charts or graphs to illustrate the findings.

10. Student will do a class required report using his/her artistic ability to illustrate the report as the primary medium. A few captions, etc., may be used for clarification. This should be acceptable to the teachers as long as all report criteria are met.

11. Student will have a cartoon or illustration published in the high school newspaper. Student may have work rejected. He/she must learn to accept rejection and develop a plan to facilitate acceptance of the next illustration.

SUGGESTIONS FOR PARENTS:

1. Have student evaluate the color schemes in the rooms in his/her home. Make suggestions for possible additions or changes to enhance what is already there.

2. Have student draw his/her room to scale. Then have student select new color schemes by going to home decorating centers and using material, wallpaper, carpet, and paint scraps and chips.

3. Have student draw room to scale and add furniture to scale then color in with new color scheme.

Temperament - indicates an ability to adapt to:

making generalizations, evaluations, or decisions based on sensory or judgmental criteria.

1. In activity 2 of the section on aptitudes the student was to select his/her most preferred drawing. Using that drawing the student will list or state the criteria used that resulted in the selection of the specific drawing. It is important that students develop the ability to make judgments on their work as objectively as possible.
2. Student will make a scrap book containing pictures and other graphics they feel represent their favorite works and give two reasons for liking each work. The notebook can have any number of sections. For example, advertisements, cartoons, pictures of children, etc.

SUGGESTIONS FOR PARENTS:

1. Have student present to family the drawings and color schemes for his/her room listing reasons for choices including why certain possibilities were not chosen.

COMMERCIAL ART

Vocational

Demonstrate knowledge of basic safety concepts.

1. Individuals working in the field of commercial art are subject to a variety of situations that could result in the need for first aid. Working with chemicals that can cause eye or skin irritations and possible problems from the inhalation of gases or vapors; pointed or sharp instruments such as paper cutters, sharp pens, compasses and X-Acto knives; possible burns, shock, fire from electrical equipment or gas vapors.
2. At the end of this manual an instructional module on first aid is provided. Students should be taught the basic first aid principles relating to safety concerns in the area of commercial art.

SUGGESTIONS FOR PARENTS:

1. Have student evaluate home for safety hazards and write up a list of concerns and recommended changes.
2. Have student put together a first aid kit for the home.

RESOURCES

COMMERCIAL ART

Collier-Macmillian Limited
866 Third Avenue
New York, NY 10022

Advertising Graphics, Bockus, H. W. Jr.

Project Discovery
Southwest Learning Resources Center
Red Oak, IA 51566

So Ya Wanna Be An Artist: Exploring Careers in Commercial Art, Odom, G., & Nelson, A.

Tudor Publishing Company
c/o Amiel Book Distributors
31 West 46th Street
New York, NY 10036

Commercial Art Techniques, Maurello, S. R.

Van Nostrand Reinhold Company
7625 Empire Drive
Florence, KY 41402

Trade Marks & Symbols, Kuwayana, Y.

DRAFTING

Sample Occupational Areas:
Drafter, Apprentice
Drafter, Architectural
Drafter, Assistant
Drafter, Civil
Die Designer, Apprentice
Drafter, Mechanical

Introduction

Students who enjoy drawing separate pieces of items to scale using line drawings and a variety of machines may enjoy the field of drafting. Accuracy in work is essential, confinement to one work area and knowledge of many technical fields are required. The work is indoors and offers little physical exercise. However, the work offers a variety of challenging assignments and an open job market with the possibility of job promotions as the worker's skills increase.

VIMS COMPETENCIES FOR DRAFTING

A. Drafting Room Procedures

1. Apply safety policies and procedures
2. Identify sources of safety requirements
3. Identify American National Standards Institute, Inc. (ANSII) and International Standards Organization (ISO) standards.

Other (specify):

B. Tools and Equipment

1. Select proper drawing instruments and equipment to complement the drafting media; i.e., Mylar, Vellum
2. Demonstrate proper use and care of drawing instruments and equipment
3. Produce electrostatic (i.e., stick-on decals), sepia, and blueline copies
4. Identify procedures for producing mylar copies
5. File original working drawings
6. Adjust drafting machine and equipment

Other (specify):

C. Basic Drawing Skills

1. Layout drawing
2. Construct borders and information blocks
3. Construct freehand sketches
4. Read and transfer measurements
5. Letter freehand (letters and numerals)
6. Demonstrate techniques in line construction
7. Letter with mechanical lettering devices and templates
8. Construct a drawing with mechanical pencils
9. Construct a drawing with technical ink pens
10. Construct a tracing using reproduction techniques and materials

Other (specify):

D. Geometric Construction

1. Bisect lines, angles and arcs
2. Construct regular polygons and elipses
3. Draw tangents to arcs, lines and circles
4. Construct involutes
5. Divide a line in equal and proportional parts

Other (specify):

E. Orthographic Drawings

1. Interpret an orthographic projection (3rd angle)
2. Prepare a multiview freehand (3rd angle)
3. Prepare orthographic drawing (3rd angle)
4. Identify use and application of orthographic drawings (3rd angle)
5. Identify 1st and 3rd angle projection drawings

Other (specify):

F. Auxiliary Views/Revolutions

1. Construct primary auxiliary views
2. Construct revolutions
3. Construct secondary auxiliary views
4. Identify use and application of auxiliary views and revolutions

Other (specify):

G. Sectional Views/Conventions

1. Draw standard sectional views
2. Identify the symbols used to represent different materials
3. Identify and use cutting planes
4. Identify and use conventional breaks
5. Identify use and application of sectional views

Other (specify):

H. Dimensioning

1. Apply dimensioning practices and techniques to drawings
2. Construct the lines to dimension drawings
3. Identify use and application of dimensioning practices
4. Identify tolerancing
5. Read and convert measurements

Other (specify):

I. Descriptive Geometry

1. Perform graphic solutions of points
2. Perform graphic solutions of lines
3. Perform graphic solutions of planes
4. Perform graphic solutions of solids
5. Perform graphic solutions of intersections

Other (specify):

J. Pictorial Drawings

1. Construct isometric drawings
2. Identify diametric, oblique, perspective and trimetric drawings
3. Identify use and application of pictorial drawings

Other (specify):

K. Introduction to Architectural Drawings

1. Construct architectural symbols
2. Produce simple floor plan and elevation drawings
3. Identify use and application of fasteners

Other (specify):

L. Introduction to Electrical/Electronic Drawings

1. Construct electrical/electronic symbols
2. Produce simple electrical/electronic drawings and schematics
3. Identify use and application of conductive fasteners
4. Identify use and application of nonconductive fasteners

Other (specify):

M. Introduction to Pipe Drawings

1. Construct piping symbols
2. Produce orthographic and isometric drawings
3. Identify use and application of fasteners

Other (specify):

N. Introduction to Structural Steel Drawings

1. Identify structural steel shapes
2. Produce a simple steel framing plan drawing
3. Produce a simple detail and assembly drawing (including beam connections) with bill of materials

Other (specify):

O. Introduction to Machine Drawings

1. Produce a simple detail and assembly drawing applying standard fits and tolerances
2. Develop a parts list
3. Identify use and application of fasteners

Other (specify):

P. Introduction to Surveying Drawings

1. Construct surveying symbols
2. Produce a simple contour plan and elevation drawing
3. Produce a simple land survey plot from written description

Other (specify):

Q. Introduction to Sheet Metal Drawings

1. Construct sheet metal symbols
2. Produce representative sheet metal drawings

Other (specify):

R. Basic Computer Assisted Drafting (CAD) Drawings

1. Identify vocabulary
2. Identify hardware and basic functions/operations
3. Produce a simple drawing
4. Store and retrieve data

Other (specify):

S. Applied Mathematical Skills

1. Apply basic mathematic principles
2. Apply basic geometric principles
3. Apply basic trigonometric principles

Other (specify):

Leadership Competencies **

1. Demonstrate an understanding of VICA, its structure and activities
2. Demonstrate an understanding of one's personal values
3. Perform tasks related to effective management skills
4. Demonstrate interpersonal skills
5. Demonstrate etiquette and courtesy

6. Demonstrate effectiveness in oral and written communications
7. Develop and maintain a code of professional ethics
8. Maintain a good professional appearance
9. Perform basic tasks related to securing and terminating employment
10. Perform basic parliamentary procedures in a group meeting

** (Note: These competencies are addressed in the Missouri VICA Curriculum Guide lessons.)

DRAFTING
ACCESS SKILLS CHECKLIST

Student Name/ID ______________________ Sending School ______________________

Instructor ______________________ Date(s) Evaluated ______________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
1 = NOT MASTERED N or blank = NO EXPOSURE

TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
1. Count two-place numbers	480100A001	3 2 1 N		
2. Add two-place numbers	480100A002	3 2 1 N		
3. Subtract two-place numbers	480100A003	3 2 1 N		
4. Perform standard units of measurement, i.e., cup, pint, quart, inch, foot, yard, ounce, pound	480100A004	3 2 1 N		
5. Use basic measuring instruments, i.e., rulers, scales	480100A005	3 2 1 N		
6. Multiply two-place numbers	480100A006	3 2 1 N		
7. Divide two-place numbers	480100A007	3 2 1 N		
8. Add common fractions	480100A008	3 2 1 N		
9. Subtract common fractions	480100A009	3 2 1 N		
10. Multiply common fractions	480100A010	3 2 1 N		
11. Divide common fractions	480100A011	3 2 1 N		
12. Add two-place decimals	480100A012	3 2 1 N		
13. Subtract two-place decimals	480100A013	3 2 1 N		
14. Multiply two-place decimals	480100A014	3 2 1 N		
15. Divide two-place decimals	480100A015	3 2 1 N		
16. Add discount, interest and percentage	480100A016	3 2 1 N		
17. Subtract discount, interest and percentage	480100A017	3 2 1 N		
18. Multiply discount, interest and percentage	480100A018	3 2 1 N		
19. Divide discount, interest and percentage	480100A019	3 2 1 N		
20. Add surface areas, values, weights and measures	480100A020	3 2 1 N		
21. Subtract surface areas, values, weights and measures	480100A021	3 2 1 N		
22. Multiply surface areas, values, weights and measures	480100A022	3 2 1 N		
23. Divide surface areas, values, weights and measures	480100A023	3 2 1 N		
24. Lift 10 lbs. maximum with occasional lifting and/or carrying of small articles, i.e., tools, ledgers (sedentary work)	480100B001	3 2 1 N		

DRAFTING
ACCESS SKILLS CHECKLIST

Student Name/ID ______________________________ Sending School ______________________________

Instructor ______________________________ Date(s) Evaluated ______________________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
1 = NOT MASTERED N or blank = NO EXPOSURE

TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
25. Extend the hands and arms in any direction (reaching)	480100B002	3 2 1 N		
26. Seize, hold, grasp, turn or otherwise work with the hand or hands (handling)	480100B003	3 2 1 N		
27. Pick, pinch, or otherwise work with the fingers (fingering)	480100B004	3 2 1 N		
28. Perceive size, shape, temperature or texture of objects and materials by using fingertips (feeling)	480100B005	3 2 1 N		
29. Ability to work inside	480100B006	3 2 1 N		
30. Think visually of geometric forms (S-spatial)	480100C001	3 2 1 N		
31. Comprehend the two dimensional representation of three-dimensional objects (S-spatial)	480100C002	3 2 1 N		
32. Recognize the relationship resulting from the movements of objects in space (S-spatial)	480100C003	3 2 1 N		
33. Perceive pertinent detail in objects in pictorial or graphic material (P-form perception)	480100C004	3 2 1 N		
34. Make visual comparisons and discriminations and see slight differences (P-form perception)	480100C005	3 2 1 N		
35. Perceive pertinent detail in written or tabular materials (Q-clerical perception)	480100C006	3 2 1 N		
36. Move the fingers and manipulate small objects with the fingers, rapidly or accurately (F-finger dexterity)	480100C007	3 2 1 N		
37. Making generalizations, evaluations, or decisions based on measurable or verifiable criteria	480100D001	3 2 1 N		
38. Situations requiring the precise attainment of set limits, tolerances, or standards	480100D002	3 2 1 N		
39. Demonstrate knowledge of basic safety concepts	480100E001	3 2 1 N		

DRAFTING VOCABULARY LIST

ACTUAL SIZE	an object's actual dimensions, the size it actually is in completed form
COMPASS	an instrument used to draw circles and arcs
COMPOSITE PRINT	print made by combining the parts of two or more masters
CONTRAST	the difference between the image and the background areas of a print
DENSITY	the darkness of an image area
DETAIL DRAWING	the complete size material and specification description of an individual part
DEVELOPMENT	any process used for rendering an image visible
DRAFTING TAPE	a specially prepared tape that does not harm surface of table or drawing media
DRAWING	graphic and lettered information on an original media surface
ERASER	a device used to remove pencil lines and graphite smudges from a drawing
ERASING SHIELD	a metal plate with various slots and openings used to protect linework when a portion of the drawing is to be erased
GRADUATIONS	the subdivisions in a scale unit, all of which are equal in size or length
HORIZONTAL	parallel to the plane of the horizon
MASTER	any original to be duplicated
MEIDA	material upon which drawings are made
PARALLEL	two lines or surface side by side, equal distance apart at all points
PROTRACTOR	an instrument used to measure angles
REAM	500 sheets of media material
REVISION	a correction made on a drawing to reflect a needed change
SCALE	an instrument used as a standard of reference when drawing an object to a proportional size

SILKSCREENING	stenciling through a silk screen to form an image
TEMPLATE	a thin, flat, plastic tool with various size openings of different shapes used to expedite the drawing of standard features
TRANSPARENT	the property of transmitting or allowing light to pass through
TRIANGLE	an instrument consisting of a thin, flat, right-angled piece of plastic or metal with acute angles of 45 degrees, or 30 degrees, and 60 degrees
VERTICAL	a line straight up and down
WATERMARK	a marking in paper which is visible when the paper is held up to the light
WORKING DRAWING	a drawing needed to manufacture, build, assemble, or install any unit, component, or structure

TOOL LIST FOR DRAFTING

- Adjustable triangle
- Ames type lettering guide
- Braddock Rowe triangle
- Compass
- Divider
- Drafting machine or parallel bar
- Drafting machine parallel bar
- Drafting tape
- Drawing paper or media
- Drawing pencil with soft lead
- Drawing surface
- Elbow drafting machine
- Hex wrench
- Horizontal machine scale
- Irregular curve
- Lead holder or pencils
- Lead pointer
- Nonabrasive hand eraser
- Paper towel or cleaning cloth
- Pencil pointer
- Protractor
- Scale or lettering guide
- Scale wrench
- Sheet of vellum without a watermark
- Standard triangles
- Vertical machine scale
- V-track drafting machine

DRAFTING

Math

Count two-place numbers
Add two-place numbers
Subtract two-place numbers
Perform standard units of measurement, i.e., cup, pint, quart, inch, foot, yard, ounce, pound
Use basic measuring instruments, i.e., rulers, scales
Multiply two place numbers
Divide two-place numbers
Add common fractions
Subtract common fractions
Multiply common fractions
Divide common fractions
Add two-place decimals
Subtract two-place decimals
Multiply two-place decimals
Divide two-place decimals
Add percentage
Subtract percentage
Multiply percentage
Divide percentage
Add surface areas, weights and measures
Subtract surface areas, weights, and measures
Multiply surface areas, weights, and measures
Divide surface areas, weights, and measures

NOTE: Many math books and workbooks provide needed direction in learning basic operations in math. This section assumes that students have basic skills and is designed to be used in conjunction with any of the math books you might be using, or to establish your own supplemental units. Any math practice activities should be developed within the context of the vocational program. Other persons to use as resources in this area include: parents and math teacher.

1. Using measurement instructional module and carpentry math activities, student will measure accurately to 1/16 of an inch.

2. Using worksheet D #1, student will measure each line and write the measurement above or next to the line measured.

3. Using worksheet D #1, student will measure lines in each box and add the total amount of each line group.

4. Student will figure surface area of worksheet D #1. Have student figure areas of various block segments such as D-J or B, etc.

5. Using worksheet D #1, student will measure distance between arrowed sections and fill in the blanks.

SUGGESTIONS FOR PARENTS:

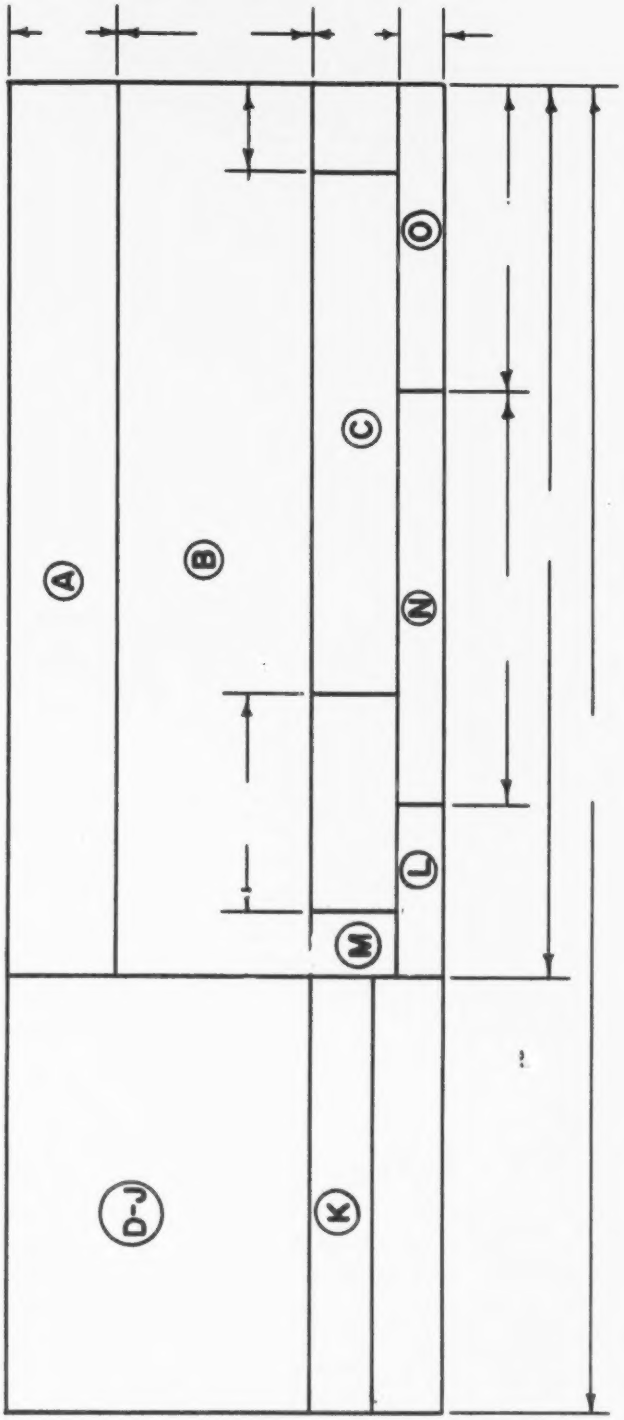
1. Have student measure a variety of items in the home such as magazine covers, kitchen utensils, and furniture.

2. Have student figure square footage of his/her bedroom.

3. Provide student with opportunity to weigh and measure items while working in the kitchen.

D #1

WORKSHEET


A
B
C
O
N
L
M
D-J
K

DRAFTING

Physical Demands/Working Environment

Lift 10 lbs. maximum and occasionally lifting and/or carrying small articles, i.e., tools, ledgers (sedentary work)
Extend the hands and arms in any direction (reaching)
Seize, hold, grasp, turn or otherwise work with the hand or hands (handling)
Pick, pinch, or otherwise work with the fingers (fingering)
Perceive size, shape, temperature or texture of objects and materials by using fingertips (feeling)
Ability to work inside

In most cases, the assessment of these skills will indicate that the student has the gross and fine motor skills which are prerequisites to learning the vocational skills in a Drafting program. Prior to instruction in any physical demands activities, the student should have been evaluated and parents contacted to make sure that the student has no hidden physical problems that could be aggravated by lifting objects or by other physical activities done in this area. However, if the student has a physical disability or other limitation(s) preventing him/her from demonstrating fine and gross motor skills, then other techniques may be taught so he/she can perform in the vocational program. Other persons to use as resources in this area include: physical education teacher, industrial arts teacher, special education teacher, and parents.

1. Student will lift a variety of items in classroom with an average weight of 10 pounds and carry them from one spot to another under teacher supervision.

2. Student will sit at table and extend (reach) as far as possible and draw large circles, squares, etc. on paper covering table.

3. Given a box filled with a variety of colored pencils (at least 30) student will sort by size, sharpen those needing sharpening and wrap each size into a bundle with an elastic band.

4. Using a template student will fill a page of paper with circles, squares, triangles, etc.

5. Using the drawings completed in activity 4, the student will use a ruler and pen to draw a line bisecting each drawing.

6. Student will evaluate preference for activities performed inside or outside to determine preferred working environment.

7. Given a drawing task, student will sit at a desk and work for 45 minutes without leaving project.

SUGGESTIONS FOR PARENTS:

1. Provide student with tasks that require at least 45 minutes to an hour to complete as well as requiring student to sit in one place. For example, rearrange recipe files, put photos in an album.
2. Have student make labels for drawers and cupboards to identify where items should be stored.

DRAFTING

Aptitudes - indicates an ability to:

think visually of geometric forms (S-spatial)
comprehend the two dimensional representation of three-dimensional objects (S-spatial)
recognize the relationship resulting from the movements of objects in space (S-spatial)
perceive pertinent detail in objects in pictorial or graphic material (P-form perception)
make visual comparisons and discriminations and see slight differences (P-form perception)
perceive pertinent detail in verbal or tabular materials (Q-clerical perception)
move the fingers and manipulate small objects with the fingers, rapidly or accurately (F-finger dexterity)

1. Give a standard protractor, student will draw circles of varying sizes on a sheet of paper.

2. Using worksheet D #2 student will match the lettering error to the statement of that error.

3. Using graph paper with 1" and then 1/2 squares student will reproduce block and round letters.

4. Using worksheets D #1 and D #3 student will duplicate the drawings using graph paper, pen and ruler.

5. Given a simple object, student will draw the object providing 1) side view, 2) top view, 3) three dimensional view. Use worksheet D #2 as a guide.

6. Given a geometry book, student will reproduce line drawings as requested by the teacher.

7. Working with an art teacher, the student will learn the art of calligraphic lettering.

SUGGESTIONS FOR PARENTS:

1. Have parents discuss with student the details of pictures in magazines.

2. Provide opportunities for student to use fingering skills, lettering materials, sorting small items, etc.

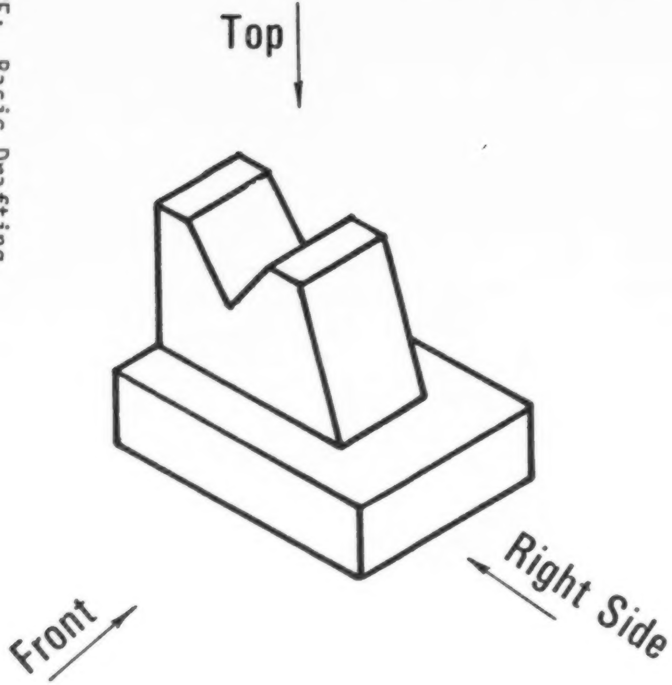
WORKSHEET

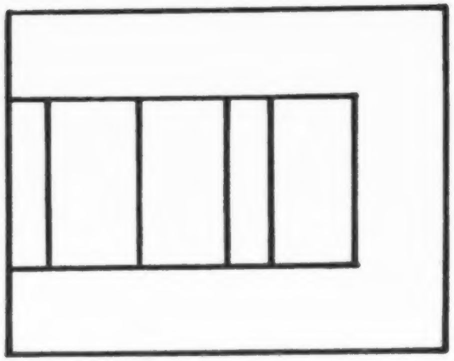
Draw a line matching the uniformity error to the statement describing that error.

A	UNiFORM	AREAS ARE NOT UNIFORM BETWEEN LETTERS
B	*U*NIFORM	LETTERS ARE NOT VERTICALLY UNIFORM
C	UNIFORM	LETTERS NOT UNIFORM IN HEIGHT
D	UN IFO R M	STYLE OF LETTERS IS NOT UNIFORM
E	UniFoRM	AREAS ARE NOT UNIFORM BETWEEN WORDS
F	GOOD LETTERINGSHOULD BE UNIFORM	LETTERS NOT UNIFORM IN STROKE THICKNESS
G	UNIFORM	UNIFORM LETTERING

Three-View Drawings

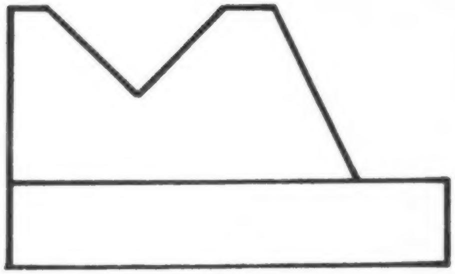
SOURCE: Basic Drafting.


Top
Front
Right Side

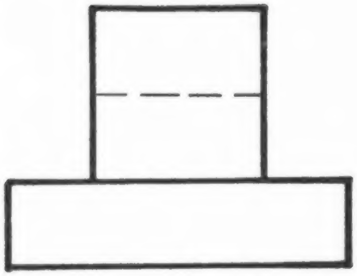


Top View

Some objects require three views to describe their shape.



Front



Right Side

WORKSHEET

D #3

Temperament - indicates ability to adapt to:

making generalizations, evaluations or decisions based on measurable or verifiable criteria
situations requiring the precise attainment of set limits, tolerances or standards

1. Provided with three types of lettering styles used for advertising different products, the student will evaluate which he/she prefers and tell the teacher at least three reasons for the preference.
2. Using worksheet D #3, the student will reproduce the line drawings to within 1/32 of an inch leeway on each line. Do not use graph paper.
3. Given a picture of a three dimensional square, student will draw the square to scale then reduce the drawing twice. The student may use graph paper.

SUGGESTIONS FOR PARENTS:

1. Have student calligraphy invitations or personal notes for home use.
2. Have student arrange items in a desk such as pens, erasers, pins, paper clips, etc. for effective use in a home office. If there is not a desk in the home them, a box can be used and sectioned off for easy use by family members.

DRAFTING

Vocational

Demonstrate knowledge of basic safety concepts

1. Instruct student in basic safety concepts by using the module on safety at the end of this manual.
2. Using worksheet D #4, student will learn safety expectations in a drafting program.

SUGGESTIONS FOR PARENTS:

1. Have student establish a list of activities to be avoided and safety procedures to follow in the home.
2. Have student locate potential unsafe areas in home and recommend possible changes.
3. Have student put together a basic first aid kit to be used in the home.

WORKSHEET

SPECIFIC RULES FOR PERSONAL SAFETY IN THE DRAFTING CLASSROOM

1. Do not misuse electrical tools, report all electrical failures immediately.

2. Use trimming shears, paper cutters and metal straight edges only for intended purposes. Do not remove guard from paper cutters.

3. Handle sharp, pointed instruments with care. Never throw a compass or a divider.

4. Avoid horseplay. More accidents result from horseplay than any other single cause.

5. Keep all four feet of drafting stools on the floor. Leaning back and tilting a drafting stool is a dangerous practice.

6. Use both hands to raise and lower drafting table tops. Be prepared to hold table top as control rod knobs are loosened.

7. Use reproduction equipment with proper care and only after instruction in its use and with the instructor's permission to use it.

8. Do not throw any objects.

9. Tag any defective electrical equipment with a "Do not use" tag and turn it in to the teacher.

RESOURCES

DRAFTING

Delmar Publishers, Inc.

Albany, NY

Basic Blueprint Reading and Sketching, Olivo, T. C., & Payne, A. V.

Goodheart Wilcox Company, Inc.

South Holland, IL

Drafting for Industry, Brown, W. C.

Mid-America Vocational Curriculum Consortium
State Department of Vocational and Technical Education
Stillwater, OK 74074

Basic Drafting Book One and Book Two

National Safety Council

Chicago, IL 60611

Safety in the Drafting Room; Safety Educators Data Sheet #95, Noll, R. F.

ELECTRONICS

Sample Occupational Areas:
Electronics Assembler
Electronics Equipment Mechanic
Electronics Inspector I
Electronic Mechanic
Office Machine Servicer

Introduction

The area of electronics is a growing field for many different kinds of jobs. Assembly jobs require excellent discrimination and fine motor skills. Repair and service jobs require a knowledge of the theory of electronics in order to troubleshoot problems. Math is a large part of the field of electronics. A basic knowledge of algebra would be helpful to students interested in this field. Many electronics courses also deal with computers, how they work and how to troubleshoot problems within the hardware.

Students interested in this area need to have dexterity and discrimination skills, including color discrimination skills. They also should have at least an average math background, enjoy problem-solving activities and produce very high quality work.

VIMS COMPETENCIES FOR ELECTRONICS

A. Electronic Safety

1. Identify various types, purposes and operation of fire extinguishers
2. Identify electrical hazards
3. Identify and practice shop safety
4. Identify and practice safe soldering methods
5. Demonstrate safe and proper use of hand tools
6. Identify hazard of RF radiation devices
7. Demonstrate safe and proper use of AC line operated equipment; i.e., isolation transformers, grounding, GFI

Other (specify):

____

____

____

B. Fundamentals of Electronics

1. Describe atomic structure and its relationship to electricity
2. Describe the basic physics of semiconductor materials
3. Describe the relationship between electrical and magnetic properties
4. Describe the electrical and magnetic properties of a magnet
5. Describe the photoelectric effect
6. Describe the thermocouple effect
7. Describe the electrical effect of friction
8. Describe the concept of resistance, voltage and current and how they relate to each other
9. Describe the concept of capacitance, voltage and current and how they relate to each other
10. Describe the concept of inductance, voltage and current and how they relate to each other
11. Solve AC network problems utilizing appropriate theorems and laws
12. Identify and test resistors
13. Identify and test capacitors
14. Identify and test inductors
15. Calculate series and parallel; resistive, capacitive and inductive networks
16. Identify and replace parts and components on printed circuit boards and chassis
17. Interpret symbols and schematic diagrams
18. Calculate RC time constant circuits
19. Describe and identify filter networks
20. Test and evaluate filter performance

Other (specify):

____

____

____

C. AC Power Supply

1. Describe types of transformers
2. Determine transformer requirements
3. Determine rectifier (diode) specifications for specific installations
4. Select components for complete power supply
5. Identify and describe use of series regulators
6. Identify and describe use of shunt regulators
7. Identify and describe use of switching regulators
8. Install power supply components
9. Test power supply and correct defects

Other (specify):

____

____

____

D. Semiconductor Devices

1. Identify schematic design symbols for semiconductor devices
2. Describe the operation of junction diodes
3. Describe the operation of Bi-polar transistors
4. Construct circuits using Bi-polar transistors
5. Describe the basic operation of a JFET
6. Describe the basic operation of a MOSFET
7. Describe the basic operation of a UJT
8. Describe the basic operation of a PUT
9. Describe the basic operation of a DIAC
10. Describe the basic operation of a SCR
11. Describe the basic operation of a TRIAC
12. Describe the basic operation of a VDR
13. Test diodes
14. Test transistors
15. Test thyristors
16. Select transistors for specific pur poses using specification sheets and substitution guides
17. Demonstrate the proper replacement techniques for semicondutor devices

Other (specify):

____

____

____

E. Amplifiers

1. Describe the operation of a Bi-polar amplifier
2. Describe the operation of a FET amplifier
3. Describe the operation of an operation al amplifier
4. Test and repair Bi-polar amplifier
5. Test and repair FET amplifier
6. Test and repair operational amplifier
7. Describe amplifier coupling techniques
8. Measure frequency response of amplifiers

Other (specify):

____

____

____

F. Frequency Generation

1. Describe the basic operation of oscillators
2. Describe the basic operation of a

crystal oscillator
3. Describe operation of phase lock loop (PLL)
4. Describe operation of waveform generators
5. Test and repair oscillators
6. Test and repair phase lock loop (PLL)
7. Test and repair waveform generators

Other (specify):

G. Receivers and Transmitters

1. Identify and describe the stages of a radio receiver, AM/FM
2. Identify and describe the stages of a radio transmitter, AM/FM
3. Describe the basic operation of microwave and satellite transmitter/receiver systems
4. Describe the operation of transmitter/receiver antennas

Other (specify):

H. Test Equipment

1. Describe the operation and demonstrate the use of an oscilloscope
2. Describe the operation and demonstrate the use of multimeters; i.e., VOM, EVM or DVM
3. Describe the operation and demonstrate the use of signal generators; i.e., audio, RF or function
4. Describe the operation and demonstrate the use of a frequency counter
5. Describe the function and application of analyzers; i.e., Signature, Data, LOGS, Spectrum or Components
6. Describe the operation and demonstrate the use of logic probes
7. Describe the operation and demonstrate the use of digital breakout boxes
8. Describe the operation and demonstrate the use of analog breakout boxes

Other (specify):

I. Microprocessor and Computer Systems

1. Identify and describe computer architecture
2. Identify the levels of computer languages
3. Describe the purpose of operating systems
4. Analyze simple programs using computer instruction sets
5. Write simple computer programs
6. Debug software
7. Describe interfacing techniques
8. Explain control and data transfer techniques to and from peripheral devices
9. Troubleshoot hardware problems

Other (specify):

J. Optical Elements

1. Describe physical aspects of light
2. Identify types of photodetectors and emitters
3. Construct a circuit using a photodetector and emitter
4. Describe optically coupled electronic systems
5. Describe optoelectronic methods of communication
6. Test and repair optical displays
7. Describe operating principles of lasers and mazers
8. Describe operation principles of optical encoders

Other (specify):

K. Digital Logic Application

1. Identify and convert number systems and codes for binary, hex, octal and BCD
2. Identify and describe the operation of basic logic gates
3. Develop truth tables defining circuit design
4. Test and repair logic circuits
5. List advantages and disadvantages of SSI, MSI, LIS and VLSI
6. Describe the characteristics of ROM's and PLA's
7. Construct combination logic circuits for a given application
8. Describe digital counter operating modes and their function
9. Construct counter and controller circuits for sequential logic applications
10. Describe the advantages of test instruments that use digital techniques
11. Use data sheets
12. Describe the operation of A/D and D/A convertors

Other (specify):

L. Electromechanical Devices and Controllers

1. Test and repair a DC motor
2. Test and repair an AC motor (single and polyphase)
3. Test and repair a stepper motor
4. Test and repair electromechanical control devices
5. Test and repair analog electronic control devices
6. Test and repair digital electronic control devices
7. Explain the proper connection of Delta and Wye motor connections
8. Describe the operation of motor speed control

9. Describe the operation of programmable controllers
   Other (specify):

M. Circuit Construction Techniques

1. Breadboarding circuits
2. Wirewrapping circuits
3. Solder/desolder circuits
4. Select and install proper components for specific use
5. Repair printed circuit boards
   Other (specify):

N. Logical Steps of Troubleshooting

1. Describe system operation using block diagram
2. Identify problem area by symptom
3. Diagnose by signal tracing and/or injecting
4. Isolate defective unit, circuit and components
5. Test for proper operation after repair
   Other (specify):

Leadership Competencies **

1. Demonstrate an understanding of VICA, its structure and activities
2. Demonstrate an understanding of one's personal values
3. Perform tasks related to effective management skills
4. Demonstrate interpersonal skills
5. Demonstrate etiquette and courtesy
6. Demonstrate effectiveness in oral and written communications
7. Develop and maintain a code of professional ethics
8. Maintain a good professional appearance
9. Perform basic tasks related to securing and terminating employment
10. Perform basic parliamentary procedures in a group meeting

** (Note: These competencies are addressed in the Missouri VICA Curriculum Guide lessons.)

ELECTRONICS
ACCESS SKILLS CHECKLIST

Student Name/ID ____________________ Sending School ____________________

Instructor ____________________ Date(s) Evaluated ____________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
1 = NOT MASTERED N or blank = NO EXPOSURE

TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
1. Count two-place numbers	470100A001	3 2 1 N	______	______
2. Add two-place numbers	470100A002	3 2 1 N	______	______
3. Subtract two-place numbers	470100A003	3 2 1 N	______	______
4. Use basic measuring instruments, i.e., rulers, scales	470100A004	3 2 1 N	______	______
5. Multiply two-place numbers	470100A005	3 2 1 N	______	______
6. Divide two-place numbers	470100A006	3 2 1 N	______	______
7. Add common fractions	470100A007	3 2 1 N	______	______
8. Subtract common fractions	470100A008	3 2 1 N	______	______
9. Multiply common fractions	470100A009	3 2 1 N	______	______
10. Divide common fractions	470100A010	3 2 1 N	______	______
11. Add two-place decimals	470100A011	3 2 1 N	______	______
12. Subtract two-place decimals	470100A012	3 2 1 N	______	______
13. Multiply two-place decimals	470100A013	3 2 1 N	______	______
14. Divide two-place decimals	470100A014	3 2 1 N	______	______
15. Add surface areas, values, weights and measures	470100A015	3 2 1 N	______	______
16. Subtract surface areas, values, weights and measures	470100A016	3 2 1 N	______	______
17. Multiply surface areas, values, weights and measures	470100A017	3 2 1 N	______	______
18. Divide surface areas, values, weights and measures	470100A018	3 2 1 N	______	______
19. Lift 20 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 10 lbs. (light work)	470100B001	3 2 1 N	______	______
20. Extend the hands and arms in any direction (reaching)	470100B002	3 2 1 N	______	______
21. Seize, hold, grasp, turn or otherwise work with the hand or hands (handling)	470100B003	3 2 1 N	______	______
22. Pick, pinch, or otherwise work with the fingers (fingering)	470100B004	3 2 1 N	______	______
23. Perceive size, shape, temperature or texture of objects and materials by using fingertips (feeling)	470100B005	3 2 1 N	______	______
24. Ability to work inside	470100B006	3 2 1 N	______	______

ELECTRONICS
ACCESS SKILLS CHECKLIST

Student Name/ID ______________________________ Sending School ______________________________

Instructor ______________________________ Date(s) Evaluated ______________________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
1 = NOT MASTERED N or blank = NO EXPOSURE

TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
25. Perceive pertinent detail in objects in pictorial or graphic material (P-form perception)	470100C001	3 2 1 N	________	________
26. Make visual comparisons and discriminations and see slight differences (P-form perception)	470100C002	3 2 1 N	________	________
27. Coordinate eyes and hands or fingers rapidly and accurately (K-motor coordination)	470100C003	3 2 1 N	________	________
28. Make a movement response accurately and swiftly (K-motor coordination)	470100C004	3 2 1 N	________	________
29. Move the fingers and manipulate small objects with the fingers, rapidly or accurately (F-finger dexterity)	470100C005	3 2 1 N	________	________
30. Match or discriminate between colors	470100C006	3 2 1 N	________	________
31. Identify a particular color or color combination	470100C007	3 2 1 N	________	________
32. Perceive contrasting color combinations	470100C008	3 2 1 N	________	________
33. Making generalizations, evaluations, or decisions based on sensory or judgmental criteria	470100D001	3 2 1 N	________	________
34. Situations requiring the precise attainment of set limits, tolerances, or standards	470100D002	3 2 1 N	________	________
35. Identify basic hand tools and equipment	470100E001	3 2 1 N	________	________
36. Use basic hand tools and equipment	470100E002	3 2 1 N	________	________
37. Demonstrate knowledge of basic safety concepts	470100E003	3 2 1 N	________	________

ELECTRONICS VOCABULARY

AC	Abbreviation for alternating current
AMPERE	Basic unit of electric current
APPLIED VOLTAGE	Total voltage supplied to a circuit; also referred to as supply voltage or source voltage
BATTERY	Group of cells connected on a series or parallel circuit
BRANCH CIRCUIT	Circuit originating from a main circuit, often one of many
BREAK VOLTAGE	Voltage level at which a diode device will switch on and conduct current
CALIBRATION	Technique of testing and adjusting an instrument by referencing it to another instrument or device of known accuracy and precision
CAPACITANCE	Property of a capacitor that opposes any change in voltage
CAPACITOR	Device used to store electrical charge
CARBON-ZINC DRY CELL	Most common type of dry cell; nominal output voltage is 1.5 volts
CHIP	Integrated circuit
CIRCUIT	A system of conductors through which an electric current is intended to flow
CIRCUIT BREAKER	Device designed to switch open a circuit automatically when a current overload exists; this device may be reset
CONTINUITY	Condition which results in a complete path for current to flow
DISCHARGE	To remove electrical energy from a charged body (capacitor or battery)
DRY CELL	A nonrechargeable source of electrical energy produced by chemical action
ELECTRICITY	An invisible force that can produce heat, light, or motion by the movement of small particles of matter called electrons
ELECTROLYTIC CAPACITOR	Capacitor that must be connected in only one direction, observing polarity

ELECTROLYTE	A substance which, in solution, is dissociated into ions and is capable of conducting an electrical current
ELECTROMOTIVE FORCE (EMF)	Force or voltage that causes current to flow through a device
ELECTRONICS	The controlled use of electricity in vacuums, gases, liquids, or vapors, and in certain semiconductor materials
FARAD	Unit of measure of capacitance
FLUX	Solution that cleans metals before or during soldering, or chemically acts to aid the fusion process
FREQUENCY	The number of cycles per second for a waveform with periodic variations
FUSE	An overcurrent protective device with an element that melts and opens the circuit when overheated; this device must be replaced
GROUND	Common return to earth for AC power lines; chassis ground in electronic equipment is the common return to one side of the internal power supply
HARDWARE	Circuitry, wiring, and devices of an electric instrument or computer
HENRY	Unit of measure of inductance
HERTZ	Unit of frequency; one Hertz equals one cycle per second
INSULATION	A substance that prohibits flow of electricity
INTERNAL RESISTANCE	Total resistance offered by a device; is normally associated with the power source
LAND	Printed wiring attached to the surface of a printed circuit board
LEAD-ACID WET CELL	Most commonly used for automobile battery; nominal output voltage is 2.1 volts; can be constructed in combinations of three (6 volt) or six cells (12 volt) batteries; lead-acid is a secondary cell and can be recharged
MAGNET	An object which will attract iron, nickel, or cobalt and which will produce an external magnetic field
MAGNETIC FIELD	The area around a magnet through which the lines of force flow

MAGNETISM	A property of certain materials which exerts a mechanical force on other materials and which can cause induced voltages in conductors when relative movement is present
MULTIMETER	Instrument capable of measuring "multiple" of values
OHMS	Unit of measure for resistance
PAD	Round terminal connection point on a printed circuit board where component lead wires are attached
PARALLEL CIRCUIT	An electronic circuit which provides more than one path (or branch) for current to flow
POWER	The rate of doing work
PRIMARY CELL	Battery that cannot be recharged
PRINTED CIRCUIT BOARD	Plastic, fiberglass, or phenolic board upon which copper strips interconnect between mounted components
REGULATOR	Circuit or device that serves to keep voltage or current output at a constant level
RELAY	An electrical switch which opens and closes a circuit automatically
RESISTANCE	Opposition to current
ROSIN	A material obtained from pine trees which is used during soldering to help ensure a good bond between the solder and the metal surfaces
SECONDARY CELL	Battery that can be recharged
SERIES CIRCUIT	A circuit where the same current passes through each component
SERIES-PARALLEL CIRCUIT	A circuit that contains some components in series and some in parallel
SHELF LIFE	Length of time a component can be stored before its operating characteristics start to degrade
SOLDER	Soft metal alloy of tin and lead used for plating or fusing metals together
SPLICE	To unite (connect) two wires to form a continuous length
STRIPPING	Removing insulation from electrical conductors

SWITCH	A mechanical or electrical device which breaks or completes a path for electrical current or routes it over a different path
THE RECIPROCAL OF A NUMBER	One (1) divided by that number
TINNING	The application of a small amount of solder to surfaces to be soldered to help ensure good wetting during soldering
TRANSISTOR	Solid-state semiconductor device usually having three terminals; varies conductivity according to voltage and current inputs
TRIGGER	Electrical impulse used to turn devices on and off
VOLT	The unit of measurement of electromotive force
VOLTAGE	Electrical force or pressure that causes the flow of electrical current (electrons)
WATT	Unit of measure for power

TOOL LIST FOR ELECTRONICS

Adjustable wire strippers
Adjustable wrench
Center punch
Combination slip-joint pliers
Component lead cleaner
Diagonal cutting pliers
Electrician's six-in-one tool
Flat file
Heat shrink tubing
Heat sink
Hemostat clamp
Hex and spline wrenches
Lineman's side cutting pliers
Long nose pliers
Mechanical wire strippers
Nut driver
Open barrel type crimp tools
Screwdrivers
Soldering gun
Soldering pencil
Soldering stands
Wire gauge

ELECTRONICS

Math Skills

Count two-place numbers
Add two-place numbers
Subtract two-place numbers
Use basic measuring instruments, i.e., rulers, scales
Multiply two-place numbers
Divide two-place numbers
Add common fractions
Subtract common fractions
Multiply common fractions
Divide common fractions
Add two-place decimals
Subtract two-place decimals
Multiply two-place decimals
Divide two-place decimals
Add surface areas, weights and measures
Multiply surface areas, weights and measures
Divide surface areas, weights and measures

NOTE: Many math books and workbooks provide needed direction in learning basic operations in math. This section assumes that students have basic skills and is designed to be used in conjunction with any of the math books you might be using, or to establish your own supplemental units. Any math practice activities should be developed within the context of the vocational program. Other persons to use as resources in this area include: parents, math teacher, and industrial arts teacher.

A student going into electronics needs practice in using formulas. If improvement is needed in basic skills of addition, subtraction, multiplication and division, use supplemental math workbooks. This section will concentrate on the use of formulas.

1. After explaining the following formulas, give student worksheet E #1.

   a. Explain the formula called KIRCHOFF's VOLTAGE LAW. This formula states that the sum of the voltage drops around a closed loop equals the source voltage.

      $E_T = E_1 + E_2 + E_3 + \ldots\ldots\ldots\ldots E_N$

      E_T = voltage source total

      $E_1 \ldots$ = voltage drops

   b. Explain KIRCHOFF's CURRENT LAW which states that the sum of currents into a point equals the current out of the point.

      $I = A_1 + A_2 + A_3 + \ldots A_N$

      I = current

      A_1 = amperes

Answers to Worksheet E #1:

1. 51 Volts
2. 25 Volts
3. 12
4. 138

2. After explaining the formula known as OHM's LAW, give the student Worksheet E #2. Ohm's Law states that as voltage goes up or down, current will do the same thing, and when resistance goes up or down, the current will do the opposite. E=IR, where E stands for volts, I stands for amperes (amps), and R stands for ohms. Explain to students that they may not know exactly what the formula means, but the purpose of the exercise is to allow them practice in using a formula they will see often in the electronics classroom.

Answers to Worksheet E #2:

1. 10 volts
2. 20 ohms
3. 5 amps
4. 33 volts
5. 19 volts
6. 22 amps
7. 16 ohms
8. .16 ohms

3. Given Worksheet E #3, student will follow the directions and solve problems to find the value of resistors.

Answers to Worksheet E #3:

1. 39000000
2. 6700000
3. 4200000000
4. 61
5. 80000
6. 52000000
7. 230
8. 180000
9. 9500
10. 59
11. 370
12. 7600

Worksheet

KIRCHOFF'S LAWS

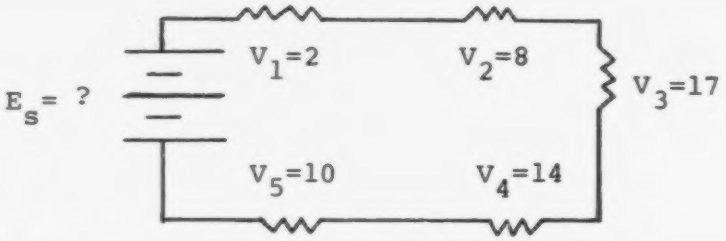
DIRECTIONS: Solve the following problems using the voltage law or the current law.

Voltage Law: $E_T = E_1 + E_2 + E_3 + \ldots E_n$

Current Law: $I = A_1 + A_2 + A_3 + \ldots A_n$

1. A circuit contains five points at which the voltage drops before reaching the source. In the diagram below, what is the source voltage?

____



2. A circuit contains three points at which there is a voltage drop. These points measure 12V, 5V and 8V. What is the source voltage?

____

3. The following amperes feed into the current source: 4A, 6A, 2A. What is the current out?

____

4. A current source has the following ampere input: 23A, 16A, 43A, 35A, and 21 A. The total current is:

____

E #2

Worksheet

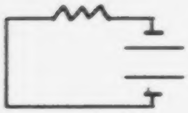
OHMS LAW

DIRECTIONS: After reviewing Ohms Law, solve the following problems:

Ohms Law: $E = IR$ $R = {}^{E}/_{I}$ $I = {}^{E}/_{R}$

E = volts I = amps R = ohms

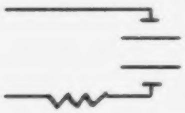
1. R = 2



E = ______

I = 5A

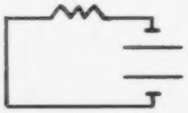
2. I = .50A



E = 40

R = ______

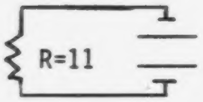
3. R = 20



E = 100

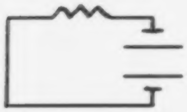
I = ______

4. I = 3



E = ______

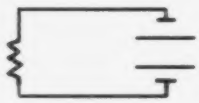
5. R = 2



E = ______

I = 9.5

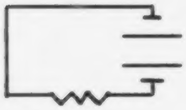
6. R = 20



E = 440

I = ______

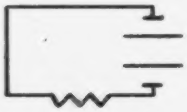
7. I = 2.5



E = 40

R = ______

8. I = 75



E = 12

R = ______

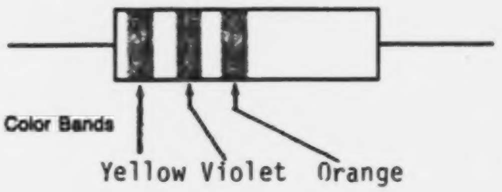
E #3

Worksheet

RESISTOR VALVE

DIRECTIONS: Resistors are color coded with 3, 4, or 5 bands. Each band indicates a certain number. Reading all the bands gives you the resistor's value in ohms. (If your teacher has a resistor, ask to look at it, or look at several to see that the color bands are different.)

Below is a picture of a resistor.



To "read" the resistor, the color bands should always be turned to the left, as shown above. Each color band indicates a number value. Below is the value assigned to each color.

Resistor Color Codes

Black -- 0

Brown -- 1

Red -- 2

Orange -- 3

Yellow -- 4

Green -- 5

Blue -- 6

Violet -- 7

Gray -- 8

White -- 9

Follow these steps in order to read the resistor value.

1. The far left band represents the first digit of the resistors value. For example, our picture shows yellow as the first band, and yellow represents the digit 4. So our first number is 4.

2. The next band tells the second digit. Out sample resistor has violet as the next band. The number for violet is 7.

   So far we have 47 as the value of our resistor.

3. The third band tells how many zeros to add after the first two digits. Our example has an orange band. Orange has a numeric value of 3. This tells us to add 3 zeros to our 47.

   47000 Our resistor value is 47,000 ohms.

Using these rules, solve the following problems.

Resistors	Colors of Bands			Answers
	1st band	2nd band	3rd band	
#1	orange	white	blue	ohms
#2	blue	violet	green	
#3	yellow	red	gray	
#4	blue	brown	black	
#5	gray	black	orange	
#6	green	red	blue	
#7	red	orange	brown	
#8	brown	gray	yellow	
#9	white	green	red	
#10	green	white	black	
#11	orange	violet	brown	
#12	violet	blue	red	

ELECTRONICS

Physical Demands/Working Environment

Lift 20 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 10 lbs. (light work)
Extend the hands and arms in any direction (reaching)
Seize, hold, grasp, turn or otherwise work with the hand or hands (handling)
Pick, pinch, or otherwise work with the fingers (fingering)
Perceive size, shape, temperature or texture of objects and materials by using fingertips (feeling)
Ability to work inside

In most cases, the assessment of these skills will indicate that the student has the gross and fine motor skills which are prerequisites to learning the vocational skills in an Electronics program. Prior to instruction in any physical demands activities, the student should have been evaluated and parents contacted to make sure that the student has no hidden physical problems that could be aggravated by lifting objects or by other physical activities done in this area. However, if the student has a physical disability or other limitation(s) preventing him/her from demonstrating fine and gross motor skills, then other techniques may be taught so he/she can perform in the vocational program. Other persons to use as resources in this area include: physical education teacher, industrial arts teacher, special education teacher, and parents.

1. Obtain a supply of used or defective components, (resistors, diodes, LED, capacitors, etc.) by calling an electronic supply store or the instructor at the area vocational school. Student will sort these components by color, then by shape.

2. Put components of different shapes and textures into a small bag. Student will be able to pull out selected components by feeling them (no use of sight).

3. Locate a guest speaker in the field of electronics. Request that she/he bring some practice boards to demonstrate soldering techniques. It would be helpful if the student(s) could also attempt to solder, under expert supervision.

4. Student will identify items in the classroom that weigh approximately 20 pounds and demonstrate ability to lift and carry those items.

SUGGESTIONS FOR PARENTS:

1. Relate student's interest/ability in performing indoor work to the teacher.

2. Encourage student to perform household tasks which require working with small items; such as, assembling a bicycle or new appliance, rewiring a lamp, etc.

ELECTRONICS

Aptitudes - indicates an ability to:

Perceive pertinent detail in objects in pictorial or graphic material (P-form perception)
Make visual comparisons and discriminations and see slight differences (P-form perception)
Coordinate eyes and hands or fingers rapidly and accurately (K-motor coordination)
Make a movement response accurately and swiftly (K-motor coordination)
Move the fingers and manipulate small objects with the fingers, rapidly or accurately (F-finger dexterity)
Match or discriminate between colors
Identify a particular color or color combination
Perceive contrasting color combinations

1. Call an electronics supply store or the electronics instructor of the area vocational school, and request a supply of different color-coded resistors. Student will sort them according to the color bars.

2. Given Worksheet E #4, student will learn the symbols and draw them when named.

3. Given Worksheet E #5, student will answer questions related to the chart.

   Answers to Worksheet E #5:

   1. ampere(s)
   2. resistance
   3. Q or q
   4. resistance
   5. voltage
   6. V or v
   7. coulomb
   8. R or r
   9. electrons
   10. circuit characteristics

4. Obtain a small electrical appliance that is broken, and allow student to take the appliance apart and put it together again. Have student draw a schematic (or picture) of how she/he takes the appliance apart, then follow this picture in putting it together again.

5. Have students work in pairs and have one student try to follow the other's schematic when reassembling the appliance.

6. Student will cut out ads in the newspaper for positions requiring training in electronics.

SUGGESTIONS FOR PARENTS:

1. Schedule a car repair or tune-up when student is able to go and watch the mechanic use the electronic equipment. If the mechanic is willing, make arrangements for student to ask questions.

2. If there are any measuring devices (meters) available through parents or friends, have the student learn to use these meters, or watch others use them.

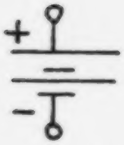
3. Allow student to participate in any repair jobs done in the home that have any electrical/electronic components. Be sure safety is stressed.

E #4

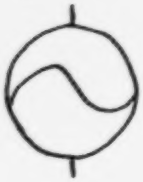
Worksheet

COMMON SYMBOLS

1. Battery



2. Generator



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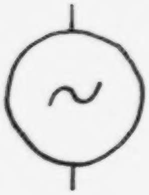
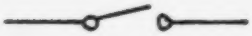
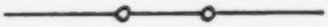


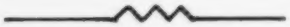
3. Open Circuit



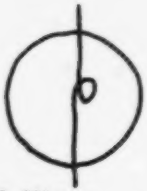
4. Closed Circuit



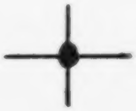
5. Resistor



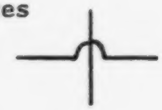
6. Lamp



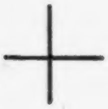
7. Connected Electrical Wires



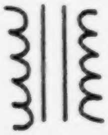
8. Not Connected Electrical Wires



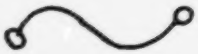
OR



9. Transformer



10. Fuse



Worksheet

CHART READING

DIRECTIONS: Study the chart below and answer the questions.

Circuit characteristics	Symbol	Source	Unit of Measure
Charge	Q or q	Electrons	Coulomb
Voltage*	E or e V or v	Potential difference between two unlike charges	Volt
Current	I or i	Number of electrons per second moving through the circuit	Ampere
Resistance (or load)	R or r	The opposition to the flow of current using energy	Ohm

(* E and e are sometimes used for generated voltages and in formulas. V and v are preferred)

1. Current is measured in ______________________________.
2. Opposition to the flow of current using energy is called __________.
3. The symbol for charge is ______________________________.
4. An ohm is a measure of ______________________________.
5. ____________ is the potential difference between two unlike sources.
6. The preferred symbol for voltage is ______________________________.
7. A charge is measured in ______________________________.
8. The symbol for resistance is ______________________________.
9. A charge is made up of ______________________________.
10. Resistance, current, voltage and charges are all part of __________.

ELECTRONICS

Temperament- Indicates an ability to adapt to:

Making generalizations, evaluations, or decisions based on sensory or judgemental criteria
Situations requiring the precise attainment of set limits, tolerances, or standards

1. Given Worksheet E #6, student will carefully read the chart from a parts catalog and answer the questions given.

   Answers to Worksheet E #6:

   1. 135D396X0060F2
   2. $22.49
   3. 850
   4. $16.06
   5. C
   6. 6
   7. 135D336X0075F2
   8. $11.13

2. Given Worksheet E #7 on reading scales, student will read correctly the four scale examples.

   Answers to Worksheet E #7:

   a. 3 volts
   b. 60 volts
   c. 125 volts
   d. 20 volts

3. Given Worksheet E #8, student will copy the diagram and label, as seen in the worksheet.

4. Student will submit only high quality work, and be able to identify errors in his/her work.

SUGGESTIONS FOR PARENTS:

1. When discussing anything with student, insist on his/her expressing logical reasons for opinions, beliefs or comments.

2. On assigned chores, require that student performs highest quality of work and, if necessary, can point out errors and perform the task over.

3. Encourage student to make decisions *after* gathering information. For example, buying clothes, look at quality, price, fit, etc. and compare before deciding what to buy.

E #6

Worksheet

PARTS CATALOG CHART

SPRAGUE Tantalum Capacitors

TYPE 135D 85° C TANTALUM CAPACITORS

Tantalum capacitors designed specifically for the severe operating environment of aerospace applications. Rated for 85° C but may be used to 175° C with appropriate derating. Meet all requirements of MIL-C-39006/22. Units have a 3-volt reverse capability and a higher permissible ripple current capability than any other electrolytic type. Glass end seals are welded to the tantalum case. Capacitors listed are ±20% tolerance with insulating sleeve. For ±10% tolerance, change the digit following the letter X from 0 to 9. For ±5% tolerance, change the 0 to 5. For uninsulated capacitors, change the last digit in the part number from 2 to 0.

Sprague Number	Cap., µF	Size Code	Net Each, Lots of 1-49	50-99	100-249	250-499
6 WVDC						
135D306X0006C2	30	C	$12.99	$11.13	$ 9.28	$ 8.90
135D686X0006C2	68	C	12.99	11.13	9.28	8.90
135D147X0006F2	40	F	17.31	14.84	12.36	11.87
135D277X0006F2	270	F	17.31	14.84	12.36	11.87
135D337X0006T2	330	T	22.49	19.28	16.06	15.42
135D567X0006T2	560	T	22.49	19.28	16.06	15.42
135D128X0006K2	1200	K	31.03	26.60	22.16	21.28
8 WVDC						
135D256X0008C2	25	C	$12.99	$11.13	$ 9.28	$ 8.90
135D566X0008C2	56	C	12.99	11.13	9.28	8.90
135D127X0008F2	120	F	17.31	14.84	12.36	11.87
135D227X0008F2	220	F	17.31	14.84	12.36	11.87
135D297X0008T2	290	T	22.49	19.28	16.06	15.42
135D437X0008T2	430	T	22.49	19.28	16.06	15.42
135D857X0008K2	850	K	31.03	26.60	22.16	21.28
10 WVDC						
135D206X0010C2	20	C	$12.99	$11.13	$ 9.28	$ 8.90
135D476X0010C2	47	C	12.99	11.13	9.28	8.90
135D107X0010F2	100	F	17.31	14.84	12.36	11.87
135D187X0010F2	180	F	17.31	14.84	12.36	11.87
135D257X0010T2	250	T	22.49	19.28	16.06	15.42
135D397X0010T2	390	T	22.49	19.28	16.06	15.42
135D757X0010K2	750	K	31.03	26.60	22.16	21.28
15 WVDC						
135D336X0015C2	33	C	$12.99	$11.13	$ 9.28	$ 8.90
135D706X0015F2	70	F	17.31	14.84	12.36	11.87
135D127X0015F2	120	F	17.31	14.84	12.36	11.87
135D177X0015T2	170	T	22.49	19.28	16.06	15.42
135D277X0015T2	270	T	22.49	19.28	16.06	15.42
135D547X0015K2	540	K	31.03	26.60	22.16	21.28
25 WVDC						
135D106X0025C2	10	C	$12.99	$11.13	$ 9.28	$ 8.90
135D226X0025C2	22	C	12.99	11.13	9.28	8.90
135D506X0025F2	50	F	17.31	14.84	12.36	11.87
135D107X0025F2	100	F	17.31	14.84	12.36	11.87
135D127X0025T2	120	T	22.49	19.28	16.06	15.42
135D187X0025T2	180	T	22.49	19.28	16.06	15.42
135D357X0025K2	350	K	31.03	26.60	22.16	21.28
30 WVDC						
135D805X0030C2	8	C	$12.99	$11.13	$ 9.28	$ 8.90
135D156X0030C2	15	C	12.99	11.13	9.28	8.90
135D406X0030F2	40	F	17.31	14.84	12.36	11.87
30 WVDC (CONT'D)						
135D686X0030F2	68	F	$17.31	$14.84	$12.36	$11.87
135D107X0030T2	100	T	22.49	19.28	16.06	15.42
135D157X0030T2	150	T	22.49	19.28	16.06	15.42
135D307X0030K2	300	K	31.03	26.60	22.16	21.28
50 WVDC						
135D505X0050C2	5	C	$12.99	$11.13	$ 9.28	$ 8.90
135D106X0050C2	10	C	12.99	11.13	9.28	8.90
135D256X0050F2	25	F	17.31	14.84	12.36	11.87
135D476X0050F2	47	F	17.31	14.84	12.36	11.87
135D606X0050T2	60	T	22.49	19.28	16.06	15.42
135D826X0050T2	82	T	22.49	19.28	16.06	15.42
135D167X0050K2	160	K	31.03	26.60	22.16	21.28
60 WVDC						
135D405X0060C2	4	C	$12.99	$11.13	$ 9.28	$ 8.90
135D825X0060C2	8.2	C	12.99	11.13	9.28	8.90
135D206X0060F2	20	F	17.31	14.84	12.36	11.87
135D396X0060F2	39	F	17.31	14.84	12.36	11.87
135D506X0060T2	50	T	22.49	19.28	16.06	15.42
135D686X0060T2	68	T	22.49	19.28	16.06	15.42
135D147X0060K2	140	K	31.03	26.60	22.16	21.28
75 WVDC						
135D355X0075C2	3.5	C	$12.99	$11.13	$ 9.28	$ 8.90
135D685X0075C2	6.8	C	12.99	11.13	9.28	8.90
135D156X0075F2	15	F	17.31	14.84	12.36	11.87
135D336X0075F2	33	F	17.31	14.84	12.36	11.87
135D406X0075T2	40	T	22.49	19.28	16.06	15.42
135D566X0075T2	56	T	22.49	19.28	16.06	15.42
135D117X0075K2	110	K	31.03	26.60	22.16	21.28
100 WVDC						
135D255X0100C2	2.5	C	$12.99	$11.13	$ 9.28	$ 8.90
135D475X0100C2	4.7	C	12.99	11.13	9.28	8.90
135D116X0100F2	11	F	17.31	14.84	12.36	11.87
135D226X0100F2	22	F	17.31	14.84	12.36	11.87
135D306X0100T2	30	T	22.49	19.28	16.06	15.42
135D436X0100T2	43	T	22.49	19.28	16.06	15.42
135D866X0100K2	86	K	31.03	26.60	22.16	21.28
125 WVDC						
135D175X0125C2	1.7	C	$12.99	$11.13	$ 9.28	$ 8.90
135D365X0125C2	3.6	C	12.99	11.13	9.28	8.90
135D905X0125F2	9	F	17.31	14.84	12.36	11.87
135D146X0125F2	14	F	17.31	14.84	12.36	11.87
135D186X0125T2	18	T	22.49	19.28	16.06	15.42
135D256X0125T2	25	T	22.49	19.28	16.06	15.42
135D566X0125K2	56	K	31.03	26.60	22.16	21.28

DIRECTIONS: Using the parts chart, answer the following questions.

1. What is the sprague number needed for a 60 WVDC, 39 cap., uF?

____

2. How much is one 125 WVDC part number 135D256X0125T2?

____

3. What is the cap., uF of the 8 WVDC part number 135D857X0008K2?

____

4. What is the cost per item for lots of 240, 15 WVDC, size code T?

____

5. What is the size code of a 30 WVDC, 15 cap., uF?

____

6. What is the WVDC number for part 135D128X0006K2, 1200 cap., uF, size code K?

____

7. What is the sprague number for 75 WVDC, 33 cap., uF?

____

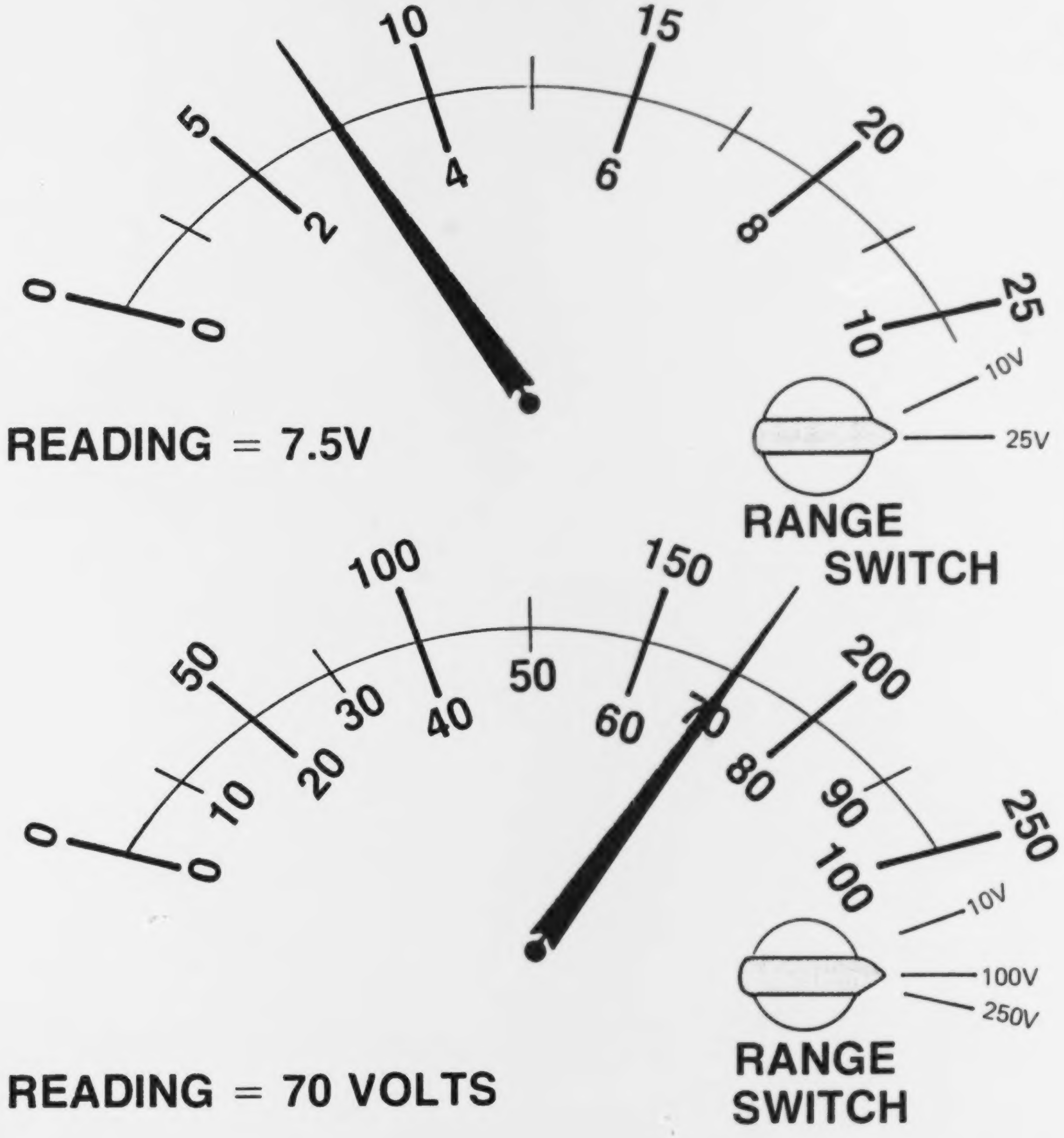
8. What is the cost per item of lots of 85, 100 WVDC, 135D475X0100C2?

____

SAMPLE SCALES

Study these scales to find out how to read them. Ask your teacher if you have any questions.

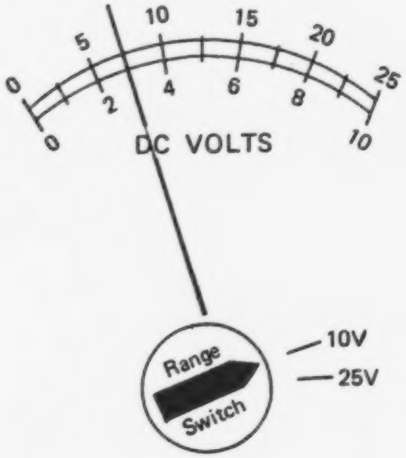
VOLTMETER SCALES AND RANGE SETTINGS

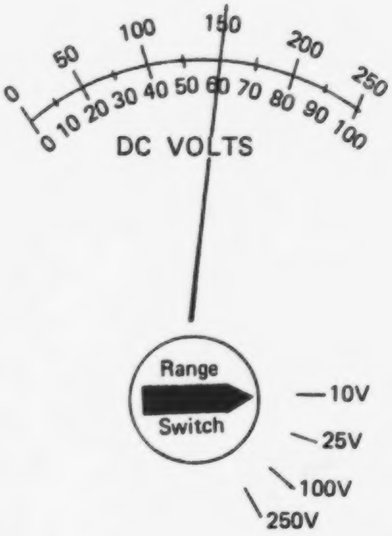

0
5
10
15
20
25
0
2
4
6
8
10
READING = 7.5V
10V
25V
RANGE SWITCH
0
50
100
150
200
250
0
10
20
30
40
50
60
70
80
90
100
READING = 70 VOLTS
10V
100V
250V
RANGE SWITCH

Worksheet

READING SCALES

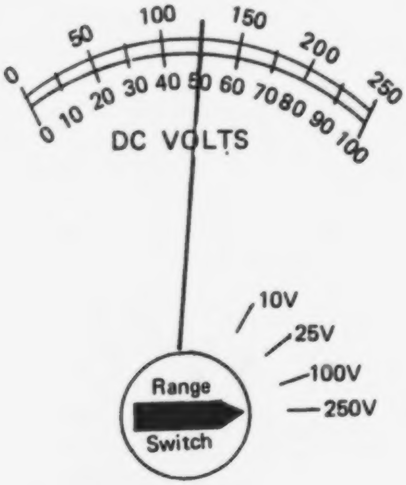
Directions: Write down the voltage reading indicated by the scales.

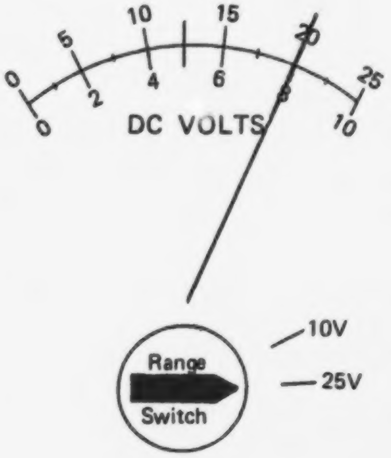

0
5
10
15
20
25
0
2
4
6
8
10
DC VOLTS
Range
Switch
10V
25V


0
50
100
150
200
250
0
10
20
30
40
50
60
70
80
90
100
DC VOLTS
Range
Switch
10V
25V
100V
250V

a. ______________________

b. ______________________

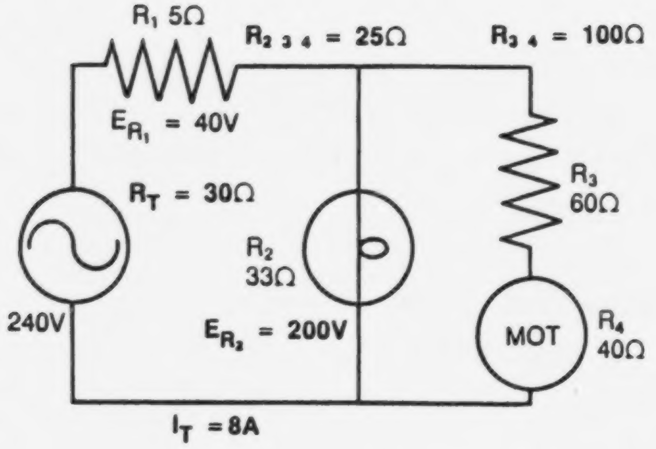

0
50
100
150
200
250
0
10
20
30
40
50
60
70
80
90
100
DC VOLTS
10V
25V
100V
250V
Range
Switch


0
5
10
15
20
25
0
2
4
6
8
10
DC VOLTS
10V
25V
Range
Switch

c. ______________________

d. ______________________

Worksheet


R_1 5Ω
$R_{2\,3\,4}$ = 25Ω
$R_{3\,4}$ = 100Ω
E_{R_1} = 40V
R_T = 30Ω
R_3
60Ω
R_2
33Ω
240V
E_{R_2} = 200V
MOT
R_4
40Ω
I_T =8A

DIRECTIONS: Draw the above diagram and label it exactly as you see it.

ELECTRONICS

Vocational

Identify basic hand tools and equipment
Use basic hand tools and equipment
Demonstrate knowledge of basic safety concepts

1. Student will identify as many tools as possible found on the tool list during a visit to the industrial education class or area vocational school's electronic class.

2. If student is enrolled in industrial arts, obtain information from that teacher on student's ability to use basic hand tools. (Otherwise, obtain this information from student and parents).

3. Student will state at least 6 general safety rules. If he/she is not able to do this, review Worksheet E #9 and have student try again.

4. Given Worksheet E #10, student will be able to state the 10 major safety rules for electronic shops.

SUGGESTIONS FOR PARENTS:

1. Discuss with the student general safety rules for the home, explaining why the rules are important.

2. If student has not had much experience in using tools, encourage their use.

3. If student enjoys putting things together, encourage him/her to construct models on a small scale which allows the student to practice using fine motor skills.

Worksheet

GENERAL SAFETY RULES

1. ALWAYS WEAR SAFETY GLASSES.
2. NEVER RUN IN A SHOP OR CLASSROOM.
3. NO "HORSEPLAY" ALLOWED IN A SHOP OR CLASSROOM.
4. NEVER OPERATE EQUIPMENT UNTIL YOUR INSTRUCTOR HAS SAID YOU COULD USE IT.
5. CLEAN UP ANY SPILLS.
6. ASK PERMISSION BEFORE USING EQUIPMENT.
7. NEVER CARRY MORE THAN YOU CAN SAFELY HANDLE.
8. DO NOT TALK TO ANYONE WHILE OPERATING A MACHINE.
9. NEVER USE DULL OR DAMAGED TOOLS. REPORT THEM TO YOUR TEACHER.
10. DON'T WORK ON MACHINES IF YOU ARE SICK, DROWSY FROM MEDICINE OR HAVE AN INJURY TO YOUR HANDS.
11. DO NOT WEAR LOOSE CLOTHING OR JEWELRY WHEN OPERATING MACHINES.
12. USE COMMON SENSE!

Worksheet

SAFETY FOR THE ELECTRONICS SHOP

1. ALWAYS CHECK CIRCUITS CAREFULLY ACCORDING TO THE WIRING DIAGRAM.
2. DO NOT WORK ON LIVE CIRCUITS (DISCONNECT FROM SOURCE OF ELECTRICITY).
3. MAKE SURE SAFETY DEVICES AND FUSES ARE USED PROPERLY.
4. READ INSTRUCTION MANUALS AND REPAIR MANUALS CAREFULLY.
5. BE VERY CAREFUL WHEN WORKING WITH CHEMICALS AND HOT SOLDERING IRONS.
6. CHECK COMPONENTS FOR STORED CHARGES. EVEN WHEN TURNED OFF, SOME COMPONENTS RETAIN ENOUGH CHARGE TO SHOCK YOU.
7. BEWARE OF WET AREAS. CLEAN UP SPILLS. WATER PROVIDES A DIRECT PATH FOR ELECTRICITY STRAIGHT INTO YOUR BODY.
8. FOLLOW THE "ONE-HAND" RULE. IF YOU MUST WORK ON A LIVE CIRCUIT, KEEP ONE HAND IN YOUR POCKET.
9. ALWAYS INSPECT ELECTRICAL EQUIPMENT FOR DEFECTS (FRAYED WIRES, LOOSE CONNECTIONS, DAMAGED CASES).
10. ALWAYS ASSUME ALL CIRCUITS ARE LIVE AND DANGEROUS.

ELECTRONICS RESOURCES

Delmar Publishers, Inc.
2 Computer Drive, West
Box 15015
Albany, NY 12212-5015
1-800-347-7707

Practical Problems in Mathematics for Electronic Technicians, Sullivan, R. L.

EMC Publishing
300 York Avenue
St. Paul, MN 55101
1-800-328-1452

Electricity and Electronics Today, Haynie, W. J. III

Mid America Vocational Curriculum Consortium, Inc.
1500 West Seventh Avenue
Stillwater, OK 74074-4364
1-800-654-3988

Basic Electronics I, Robertson, L. P.
Basic Electronics, Hartman, L.

Motivation Development, Inc.
3100 C, West Link Street
P.O. Box 427
Bishop, CA 93514
1-800-233-3391

Practical Uses for Formulas and Equations, Wiltsie, D.

HEATING, AIR CONDITIONING AND REFRIGERATION

Sample Occupational Areas:
Air Conditioning Installer/Servicer
Furnace Installer Helper
Furnace Intaller/Repairer Helper
Refrigeration Mechanic
Sheet Metal Worker

Introduction

The field of heating, air conditioning and refrigeration provides an individual with the opportunity to do a variety of tasks both in an indoor and an outdoor setting. An individual with good manual dexterity, an ability to work with basic math formulas, and an interest in working with motors and electricity should do well in this field.

VIMS COMPETENCIES FOR HEATING, AIR CONDITIONING AND REFRIGERATION

A. Safety

1. Identify types, purposes and operation of fire extinguishers
2. Inspect shop for hazards
3. Work cautiously and safely
4. Demonstrate removal procedures from an electrical conductor
5. Demonstrate knowledge of safe refrigerant handling

Other (specify):

B. Basic Refrigeration

1. Identify principles of refrigeration
2. Use high and low manifold gauge
3. Leak-test and evacuate system
4. Identify sealed system components
5. Identify sealed system accessories
6. Resolve high and low suction discharge pressure problems
7. Test temperatures

Other (specify):

C. Tubing and Connections

1. Identify different types of tubing and fittings
2. Demonstrate safety procedures and precautions
3. Install, repair and replace copper tubing
4. Install, repair and replace aluminum tubing
5. Install and replace plastic tubing and pipe
6. Braze tubing
7. Identify and use related tools and instruments
8. Use tools and instruments safely

Other (specify):

D. Basic Electricity

1. Demonstrate safety procedures and precautions
2. Describe the major concepts of electrical theory
3. Identify and use test equipment
4. Interpret electrical diagrams
5. Trouble shoot complete electrical circuit
6. Test capacitors
7. Install circuit wiring to local code
8. Describe the major concepts of electric motor theory
9. Test electrical components

Other (specify):

E. Controls

1. Demonstrate safety procedures and precautions
2. Describe concept of control theory and application
3. Install, replace and adjust electrical controls
4. Install and replace temperature pressure control
5. Adjust temperature pressure control
6. Install and replace solid-state control
7. Replace, calibrate and adjust temperature control
8. Install, repair, replace and adjust time control
9. Install and replace water regulating valve
10. Install and replace regulating valve
11. Install and replace oil pressure safety control
12. Install and replace pneumatic controls
13. Install, replace and repair magnetic starter and components
14. Install and replace current relay
15. Install and replace potential relay
16. Install and replace control relay
17. Install and replace transformer
18. Describe concept of programmable thermostats
19. Identify the components of a 4-way reversing valve

Other (specify):

F. Domestic Refrigeration

1. Demonstrate safety procedures and precautions
2. Test compressor efficiency
3. Install and replace compressor
4. Install and replace access valve
5. Repair and replace condenser
6. Repair and replace evaporator
7. Repair and replace metering devices
8. Replace components of defrost system
9. Replace temperature controls
10. Replace motor control devices
11. Replace heaters
12. Perform cleanup of a contaminated system
13. Charge refrigeration system
14. Perform preventative maintenance
15. Interpret wiring diagram - refrigerator
16. Check and adjust air flow
17. Identify and use related tools and instruments

Other (specify):

G. Commercial Refrigeration

1. Test compressor efficiency
2. Install, replace and repair compressor
3. Install and replace condensing unit
4. Install, repair and replace stem-type valve

5. Install, replace and test control valves
6. Repair and replace condenser
7. Repair and replace evaporator
8. Replace and repair metering device
9. Adjust metering device
10. Replace defrost system components
11. Replace heaters
12. Perform cleanup of a contaminated system
13. Charge refrigeration system
14. Check and adjust air flow
15. Identify and use related tools and instruments
16. Pump down unit
17. Perform preventative maintenance
18. Interpret wiring diagram

Other (specify):

H. Residential/Light Commercial Cooling/Heating

1. Demonstrate safety procedures and precautions
2. Test compressor efficiency
3. Install and replace compressor
4. Install and replace condensing unit
5. Repair and replace condenser
6. Repair and replace evaporator
7. Install, replace and test control valves
8. Replace and repair metering devices
9. Adjust metering device
10. Perform cleanup of a contaminated system
11. Charge air conditioning system
12. Check capacity of cooling system
13. Interpret wiring diagram - cooling system
14. Describe operation of a heat pump
15. Interpret wiring diagram - heat pump
16. Check capacity of heat pump
17. Replace defrost system components - heat pump
18. Start and check a residential heating and cooling system
19. Describe concept of balance points
20. Identify and describe operation of heating system components
21. Interpret wiring diagrams - heating systems
22. Start and adjust a furnace
23. Check and adjust air flow
24. Install and replace electric motor
25. Repair, replace and service electronic air cleaner
26. Perform preventative maintenance
27. Pump down unit
28. Remove and replace drier cartridge
29. Clean, repair and maintain cooling tower
30. Identify and use related tools and instruments

Other (specify):

I. Diagnosing and Problem Solving

1. Perform systematic problem solving of an air system
2. Perform systematic problem solving of an electrical system
3. Perform systematic problem solving of a fuel system
4. Perform systematic problem solving of a refrigerant system

Other (specify):

J. Fundamentals of Air Conditioning

1. Interpret psychrometric chart
2. Solve psychrometric problems
3. Measure air qualities; i.e., dry bulb, wet bulb, CFM
4. Describe concept of air treatment
5. Describe concept of heat loss and heat gain factors
6. Identify and use related tools and instruments

Other (specify):

K. Customer Sales and Relations

1. Fill out service report

Other (specify):

Leadership Competencies **

1. Demonstrate an understanding of VICA, its structure and activities
2. Demonstrate an understanding of one's personal values
3. Perform tasks related to effective management skills
4. Demonstrate interpersonal skills
5. Demonstrate etiquette and courtesy
6. Demonstrate effectiveness in oral and written communications
7. Develop and maintain a code of professional ethics
8. Maintain a good professional appearance
9. Perform basic tasks related to securing and terminating employment
10. Perform basic parliamentary procedures in a group meeting

** (Note: These competencies are addressed in the Missouri VICA Curriculum Guide lessons.)

HEATING, AIR CONDITIONING AND REFRIGERATION
ACCESS SKILLS CHECKLIST

Student Name/ID ____________________ Sending School ____________________

Instructor ____________________ Date(s) Evaluated ____________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
1 = NOT MASTERED N or blank = NO EXPOSURE

TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
1. Count two-place numbers	470200A001	3 2 1 N		
2. Add two-place numbers	470200A002	3 2 1 N		
3. Subtract two-place numbers	470200A003	3 2 1 N		
4. Perform standard units of measurement, i.e., cup, pint, quart, inch, foot, yard, ounce, pound	470200A004	3 2 1 N		
5. Use basic measuring instruments, i.e., rulers, scales	470200A005	3 2 1 N		
6. Multiply two-place numbers	470200A006	3 2 1 N		
7. Divide two-place numbers	470200A007	3 2 1 N		
8. Add common fractions	470200A008	3 2 1 N		
9. Subtract common fractions	470200A009	3 2 1 N		
10. Multiply common fractions	470200A010	3 2 1 N		
11. Divide common fractions	470200A011	3 2 1 N		
12. Add two-place decimals	470200A012	3 2 1 N		
13. Subtract two-place decimals	470200A013	3 2 1 N		
14. Multiply two-place decimals	470200A014	3 2 1 N		
15. Divide two-place decimals	470200A015	3 2 1 N		
16. Add surface areas, values, weights and measures	470200A016	3 2 1 N		
17. Subtract surface areas, values, weights and measures	470200A017	3 2 1 N		
18. Multiply surface areas, values, weights and measures	470200A018	3 2 1 N		
19. Divide surface areas, values, weights and measures	470200A019	3 2 1 N		
20. Lift 100 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 50 lbs. (heavy work)	470200B001	3 2 1 N		
21. Ascend or descend, i.e., ladders, stairs, scaffolding, using the feet and legs and/or hands and arms (climbing)	470200B002	3 2 1 N		
22. Maintain body equilibrium to prevent falling when walking, standing, crouching or running (balancing)	470200B003	3 2 1 N		
23. Bend body downward and forward by bending the spine at the waist (stooping)	470200B004	3 2 1 N		

HEATING, AIR CONDITIONING AND REFRIGERATION
ACCESS SKILLS CHECKLIST

Student Name/ID ______________________ Sending School ______________________

Instructor ______________________ Date(s) Evaluated ______________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
1 = NOT MASTERED N or blank = NO EXPOSURE

TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
24. Bend legs at the knees to come to rest on the knee or knees (kneeling)	470200B005	3 2 1 N	________	________
25. Bend body downward and forward by bending the legs and spine (crouching)	470200B006	3 2 1 N	________	________
26. Move about on the hands and knees or hands and feet (crawling)	470200B007	3 2 1 N	________	________
27. Extend the hands and arms in any direction (reaching)	470200B008	3 2 1 N	________	________
28. Seize, hold, grasp, turn or otherwise work with the hand or hands (handling)	470200B009	3 2 1 N	________	________
29. Pick, pinch, or otherwise work with the fingers (fingering)	470200B010	3 2 1 N	________	________
30. Perceive size, shape, temperature or texture of objects and materials by using fingertips (feeling)	470200B011	3 2 1 N	________	________
31. Ability to work both inside and outside	470200B012	3 2 1 N	________	________
32. Ability to work in extreme noise, constant or intermittent, causing marked distraction or possibly injury to hearing	470200B013	3 2 1 N	________	________
33. Ability to work in extreme vibration, i.e., strain on body or extremities from repeated motion or shock	470200B014	3 2 1 N	________	________
34. Ability to work in hazardous situations, i.e., risk of bodily injury	470200B015	3 2 1 N	________	________
35. Ability to work in hazardous conditions, i.e., fumes, odors, toxic conditions, dust and poor ventilation	470200B016	3 2 1 N	________	________
36. Perceive pertinent detail in objects in pictorial or graphic material (P-form perception)	470200C001	3 2 1 N	________	________
37. Make visual comparisons and discriminations and see slight differences (P-form perception)	470200C002	3 2 1 N	________	________
38. Coordinate eyes and hands or fingers rapidly and accurately (K-motor coordination)	470200C003	3 2 1 N	________	________
39. Make a movement response accurately and swiftly (K-motor coordination)	470200C004	3 2 1 N	________	________

HEATING, AIR CONDITIONING AND REFRIGERATION
ACCESS SKILLS CHECKLIST

Student Name/ID ____________________ Sending School ____________________

Instructor ____________________ Date(s) Evaluated ____________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
1 = NOT MASTERED N or blank = NO EXPOSURE

TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
40. Move the fingers and manipulate small objects with the fingers, rapidly or accurately (F-finger dexterity)	470200C005	3 2 1 N		
41. Move the hands easily and skillfully (M-manual dexterity)	470200C006	3 2 1 N		
42. Work with the hands in placing and turning motions (M-manual dexterity)	470200C007	3 2 1 N		
43. Making generalizations, evaluations, or decisions based on measurable or verifiable criteria	470200D001	3 2 1 N		
44. Situations requiring the precise attainment of set limits, tolerances, or standards	470200D002	3 2 1 N		
45. Identify basic hand tools and equipment	470200E001	3 2 1 N		
46. Use basic hand tools and equipment	470200E002	3 2 1 N		
47. Demonstrate knowledge of basic safety concepts	470200E003	3 2 1 N		

HEATING, AIR CONDITIONING AND REFRIGERATION
VOCABULARY LIST

AIR FILTER	device for removing impurities from the air
CAULKING COMPOUND	a heavy paste used for sealing a joint to make it air or watertight
CONDENSATION	liquid which occurs when a gas or vapor is cooled below its dew point
CONDUCTOR	any material with the ability to permit passage of electrical current
CRISPER	compartment in a refrigerator which provides high humidity and cool temperature for keeping fresh leafy vegetables cool and crisp
CURRENT	flow of electrons through a conductor measured in amperes
DAMPER	valve for controlling air flow
DATA PLATE	tag on the refrigerator which gives the vital electrical and refrigerant charge information
DOMESTIC REFRIGERATION	refrigerated appliance which is used within the home
ELECTRONS	negatively charged particles
GASKET	resilient or flexible material used around refrigerator doors to provide a leak-proof seal
INSULATOR	material with an extremely high resistance to current flow
LOAD	power consuming device
MERCURY BULB	thermostat contacts consisting of a small amount of liquid mercury sealed in a glass tube
PARALLEL CIRCUIT	current has more than one path it can take
RESISTANCE	opposition to current flow measured in ohms
SASH	the portion of a double hung window which slides up and down
SERIES CIRCUIT	current has only one path it can take
THERMOSTAT	device which senses temperature conditions and, in turn, acts to control a circuit

VOLTAGE (EMF)	potential difference which causes current to flow
WATT	unit of power measurement
WINDOW AIR CONDITIONER	a refrigeration device which is placed in a window or through the wall to control temperature, humidity, cleanliness, and movement of air in a limited space

TOOL LIST FOR HEATING, AIR CONDITIONING AND REFRIGERATION

Ammeter

Ball peen hammer

Battery

Center punch

Copper wire

Diagonal cutters

Drill

Drill bits

Dry cell battery

Duct tape

Flashlight

Flat tip screwdriver

Fuse

Generator

Hammer

Level

Long nose pliers

Nut drivers

Ohmeter

Open end wrench

Phillips screwdriver

Pliers

Refrigeration gauge set

Rosin core solder

Safety glasses

Scratch awl

Soft face hammer

Soldering gun

Tape measure

Thermometer

Voltmeter

Wall outlets

Watt meter

Wire stripper

Wire terminal

HEATING, AIR CONDITIONING AND REFRIGERATION

Math Skills

Count two-place numbers
Add two-place numbers
Subtract two-place numbers
Perform standard units of measurement, i.e., cup, pint, quart, inch, foot, yard, ounce, pound
Use basic measuring instruments, i.e., rulers, scales
Multiply two-place numbers
Divide two-place numbers
Add common fractions
Subtract common fractions
Multiply common fractions
Divide common fractions
Add two-place decimals
Subtract two-place decimals
Multiply two-place decimals
Divide two-place decimals
Add surface areas, weights, and measures
Subtract surface areas, weights and measures
Multiply surface areas, weights and measures
Divide surface areas, weights and measures

NOTE: Many math books and workbooks provide needed direction in learning basic operations in math. This section assumes that students have basic skills and is designed to be used in conjunction with any of the math books you might be using, or to establish your own supplemental units. Any math practice activities should be developed within the context of the vocational program. Other persons to use as resources in this area include: parents, math teachers and the vocational area instructor.

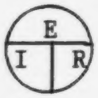
1. Student will work problems using the Ohm's law formula (Worksheet AC/R #1). It is not necessary that student understand the total concept behind Ohm's law. He/she does need to know that problems using this formula will be an important part of the AC/R program. The formula establishes a mathematical relationship between potential (voltage), current flow (amperage) and resistance (ohms). The equation symbols are:

    E = potential measured in volts
    I = current flow measured in amperes
    R = resistance measured in ohms

    Equation symbols for the Ohm's formula are:

    $E = I \times R$
    $I = E / R$
    $R = E / I$

    The symbol to help students remember the formula is:



Answers to Worksheet AC/R #1:

1. 30 amps
2. 30 ohms
3. 240 volts
4. 440 volts
5. 40 ohms
6. 24 volts
7. 4 amps
8. 60 ohms

2. Student will talk with science teacher about the basic concept of electricity and power flow as it relates to the use of Ohm's law and Watts' law for DC power.

3. Student will solve problems using Watts' law for DC power (Worksheet AC/R #2). This law establishes a mathematical basis for the amount of work done (or electricity used). The amount of wattage is the basis of the electric bill.

Equation for obtaining wattage (P is the letter symbol for power measured in watts):

$$P = E \times I$$

$$P = I^2$$

$$P = \frac{E^2}{R}$$

Common conversion of wattage:

1000 watts = 1 kilowatt (kw)
1,000,000 watts = 1 megawatt
747 watts = 1 horsepower (hp)
1 watt-hour = 3.413 b.t.u.'s

Answers to Worksheet AC/R #2:

1.	14.4 kw	14,400 watts
2.	4.8 kw	4,800 watts
3.	24.0 kw	24,000 watts
4.	30.0 kw	30,000 watts
5.		.96 watts

4. Student will discuss with teacher the three primary components of a complete electrical circuit and how it relates to the formulas of Ohms law and Watts law for DC power.

Components are:
1. Power source
2. Connecting wiring
3. Load (power consuming device)

(Sometimes a switch or control is added)

Have student locate these on worksheets AC/R # 1 and #2.

5. Student will read an electric watt-hour meter and compute kilowatt hours used in a month. See worksheet AC/R #3.

   Answers to Worksheet AC/R #3:

   1. 7125
   2. 8800
   3. 1675

6. For additional practice in volume and area computations, refer to the machinest program math section.

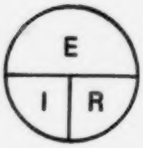
SUGGESTIONS FOR PARENTS:

1. Have student read the meter on your home. Allow him/her to look at old electric bills and compute usage.

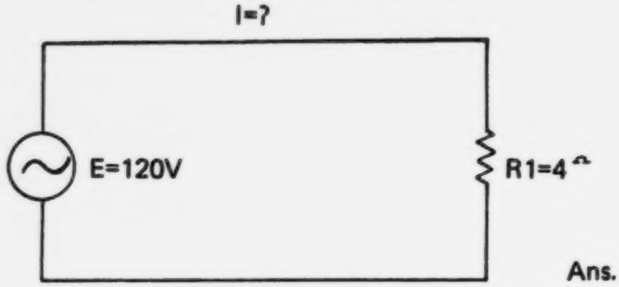
2. Have student measure windows and determine what size window air conditioner would fit in the window. Use a Sears or Penney's catalogue as a guide.

WORKSHEET

Use Ohm's law to solve the following problems.

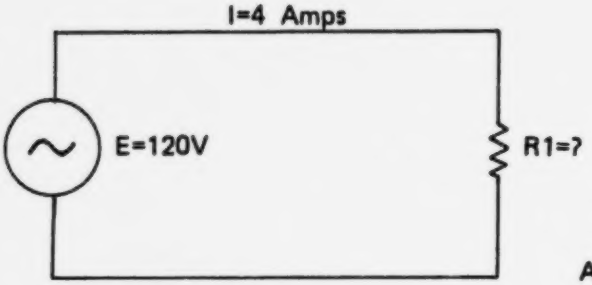


1.


I=?
E=120V
R1=4 Ω

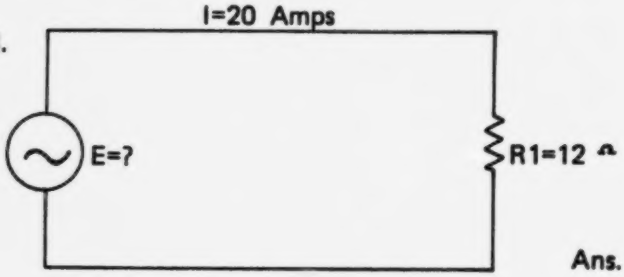
Ans. ____________

2.


I=4 Amps
E=120V
R1=?

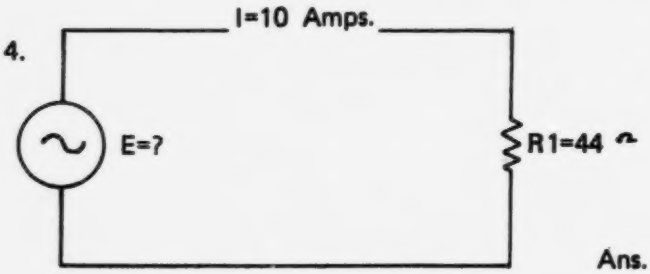
Ans. ____________

3.


I=20 Amps
E=?
R1=12 Ω

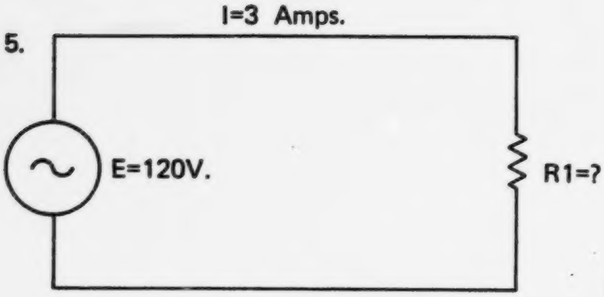
Ans. ____________

4.


I=10 Amps.
E=?
R1=44 Ω

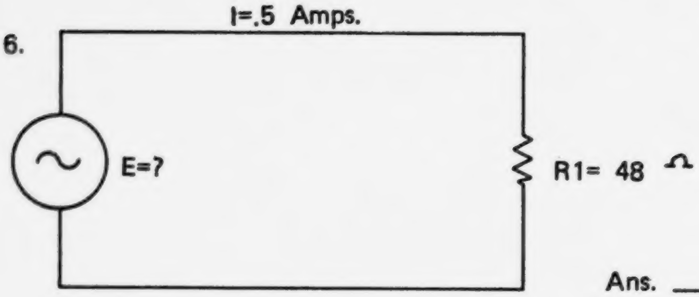
Ans. ____________

5.


I=3 Amps.
E=120V.
R1=?

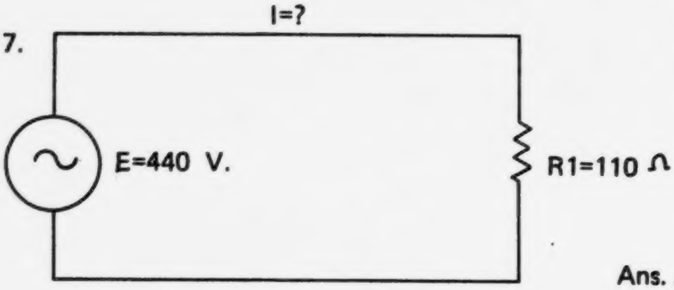
Ans. ____________________

6.


I=.5 Amps.
E=?
R1= 48 Ω

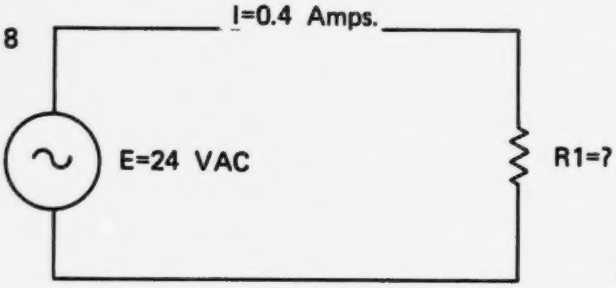
Ans. ____________________

7.


I=?
E=440 V.
R1=110 Ω

Ans. ____________________

8


I=0.4 Amps.
E=24 VAC
R1=?

Ans. ____________________

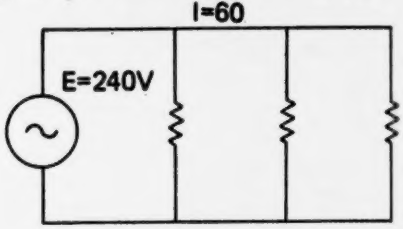
WORKSHEET

SOLVE FOR WATTAGE

Use the equations below to solve the following problems.

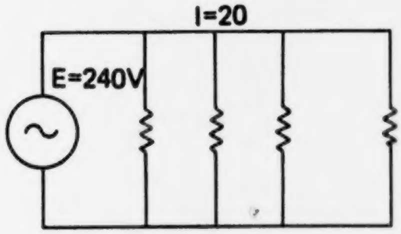
$P = E \times I$, $P = I^2 \times R$, $P = E^2/R$

1.



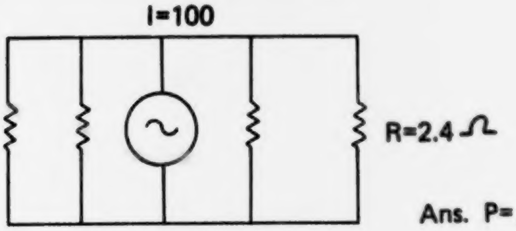
Ans. P= ____________

2.



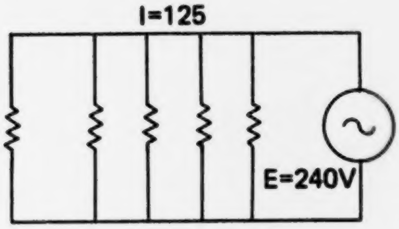
Ans. P= ____________

3.



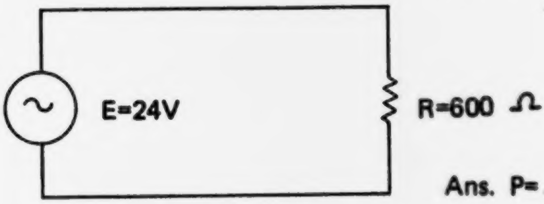
Ans. P= ____________

4.



Ans. P= ____________

5.



Ans. P= ____________

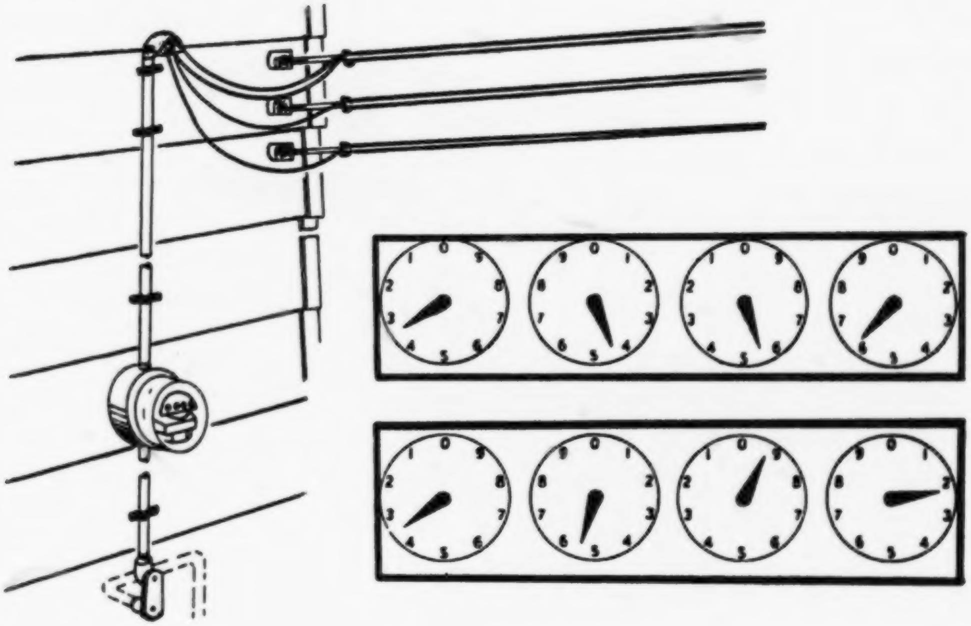
AC/R #3

WORKSHEET

READ AN ELECTRIC WATT-HOUR METER

The electric meter on the house shows how much current has been used in a given amount of time. This is done by reading a series of dials.

Example:

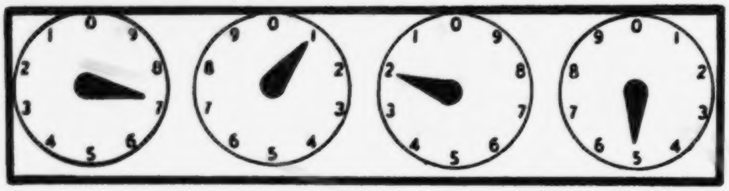


The power company's "watt-meter" has four dials. Each dial has a hand. Note that two dials read clockwise and two read counter-clockwise.

Write down the number that the hands has just passed on each of the dials in the top now. The readings on the top dial are 3456 (KWH) kilowatt hours. This will be called last month's reading. The bottom now will be the end of the next month's reading. It is 3592 KWH. The amount of current used during the month is found by subtracting last month's reading 3456 from this month's reading 3592. What is the difference?
The answer should be 136.

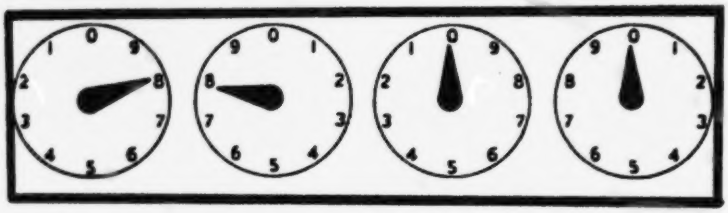
Do the following exercise on your own:

1. Read the following dials:



ans. ____________________

2. Read the following dials:



ans. ____________________

3. How many kilowatt hours were consumed between problems one and two?

ans. ____________________

Physical Demands/Working Environment

Lift 100 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 50 lbs. (heavy work)

Ascend or descend, i.e., ladders, stairs, scaffolding, using the feet and legs and/or hands and arms (climbing)

Maintain body equilibrium to prevent falling when walking, standing, crouching or running (balancing)

Bend body downward and forward by bending the spine at the waist (stooping)

Bend legs at the knees to come to rest on the knee or knees (kneeling)

Bend body downward and forward by bending the legs and spine (crouching)

Move about on the hands and knees or hands and feet (crawling)

Extend the hands and arms in any direction (reaching)

Seize, hold, grasp, turn or otherwise work with the hand or hands (handling)

Pick, pinch, or otherwise work with the fingers (fingering)

Perceive size, shape, temperature or texture of objects and materials by using fingertips (feeling)

Ability to work both inside and outside

Ability to work in extreme noise, constant or intermittent, causing marked distraction or possible injury to hearing

Ability to work in extreme vibration, i.e., strain on body or extremities from repeated motion or shock

Ability to work in hazardous situations, i.e., risk of bodily injury

Ability to work in hazardous conditions, i.e., fumes, odors, toxic conditions, dust and poor ventilation

In most cases, the assessment of these skills will indicate that the student has the gross and fine motor skills which are prerequisites to learning the vocational skills in a Heating and Air Conditioning program. Prior to instruction in any physical demands activities, the student should have been evaluated and parents contacted to make sure that the student has no hidden physical problems that could be aggravated by lifting objects or by other physical activities done in this area. However, if the student has a physical disability or other limitation(s) preventing him/her from demonstrating fine and gross motor skills, then other techniques may be taught so he/she can perform in the vocational program. Other persons to use as resources in this area include: physical education teacher, industrial arts teacher, special education teacher, and parents.

Provide an extensive background for students on the importance of doing physical skills correctly and carefully. A variety of outside resources such as the following are available.

a. Speaker from OSHA who would address the number of accidents that occur each year due to workers not protecting their bodies by using proper lifting techniques or overextending themselves.

b. Have the school nurse or health care worker demonstrate what happens to a person's body when they lift heavy objects and how the students can build bodies up to being able to lift necessary objects on the job.

c. Videotapes are helpful. National Safety Council has helped develop an eight minute file entitled, "A New Way to Lift," which can be rented from the University of Missouri-Columbia Academic Support Center.

1. Student will demonstrate proper lifting techniques. Go over the details in Worksheets AC/R #4 and AC/R #4a that provide step-by-step instruction on proper lifting techniques.

2. Student will demonstrate adequate skill in the areas of lifting to 50 lbs., agility, eye hand coordination and recognizing right from left by completing activities in the instructional module "Physical Demand Movements" located at the end of this manual.

3. Student will climb and descend ladders using correct techniques. See physical demands module.

4. Given a variety of wires and a roll of electrician's tape (masking tape may be used, but it is not as bulky as electrician's tape) student will tape 3 pieces of wire together using a spiral wrap and covering the entire lengths of wire. Spiral wrap is one in which the tape overlaps but doesn't completely cover the last circle of tape as it progresses from one end of the object to the other.

5. Student will glue objects onto a diagram completely outlining the diagram. Enlarge the electrical circuit example in Worksheet AC/R #1. Provide the student with toothpicks, tweezers and white glue. Have the student glue the toothpicks to the diagram using the tweezers to place them on paper.

6. Given assorted pipes, nuts and bolts student will practice creating items. Student should eventually see how quickly he/she can put nuts and bolts together. Trying to increase speed the student can work against own best time.

7. Student will visit an industrial arts program when machines are in use to determine the effect high noise levels may have on his/her concentration.

8. Student will bend, stoop and crawl on floor to pick up a box of nuts, bolts and washers that have been dropped on the floor.

9. Given a box of assorted nuts, bolts, screws, wire, nails, files and washers student will identify by name and relative size, i.e., small, medium, and large.

SUGGESTIONS FOR PARENTS:

1. Observe student setting up, climbing, and descending a ladder. Report observations to the teacher.

2. Watch student while lifting objects of different weights. Remind student to use proper lifting techniques.

3. Show student the thermostat in the home and teach him/her how to operate it for heating or cooling.

4. Have student vacuum the bottom and back of the refrigerator. Explain the purpose of insulation and the importance of keeping these parts as clean as possible (i.e., better air flow, etc.).

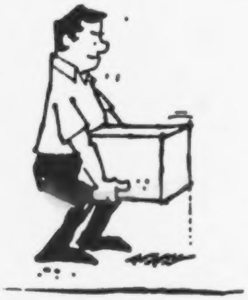
AC/R #4

WORKSHEET

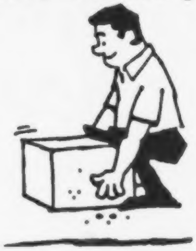
Your backbone or spinal column is the nerve network of your entire body. The spinal column is designed to support the upper section of the body, but the muscles in the back are not designed for lifting and severe strain. The back muscles are flattened and offer support to the spinal column. By contrast, the muscles in your upper thighs and lower leg are the largest in your body--and the strongest. They are designed for running, pulling, jumping, and lifting. You must learn to use your legs to lift--not your back.

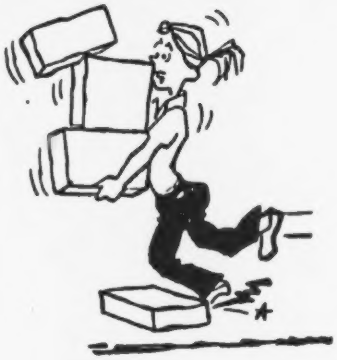
When picking up a carton--even one that appears light in weight--bend your knees and let your leg muscles lift the weight. Keep your back in a straight line. Strain comes from bending the back slightly at an angle when lifting. Even more dangerous is to twist the back slightly to one side when lifting. A full bend is better than a half bend (Luter, 1979).

Lift the load straight up--smoothly and evenly. Pushing with your legs, keep the load close to your body.



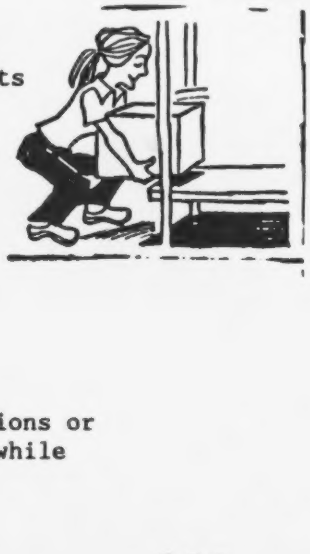
Setting the load down is just as important as picking it up. Using leg and back muscles, comfortable lower load by bending your knees. When load is securely in place, release your grip.

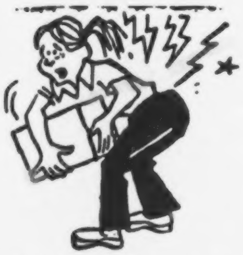




Stack material in such a way as to permit full view while carrying.

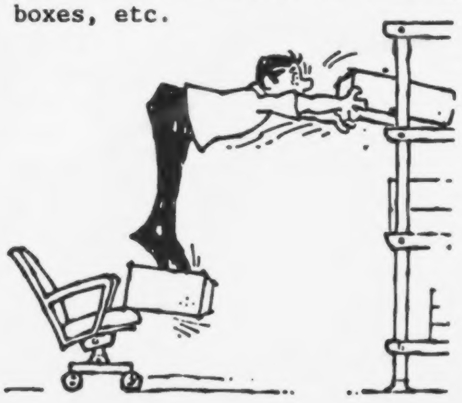
Avoid strain by storing heavy objects at least 12 inches above the floor.





Avoid awkward positions or twisting movements while lifting.

Overreaching and stretching to reach overhead objects may result in strains or falls. Use a ladder instead of chairs, boxes, etc.



WORKSHEET

PROPER LIFTING TECHNIQUES WORKSHEET

1. Size up the load to be lifted. Do not even attempt to lift a large load alone. If you have any doubt about your ability to lift an object, ask for assistance.

2. Make sure you are well-balanced. Your feet should be apart to give you a broad base of support if you are lifting a heavy object or person.

3. Move close to what you are to lift. Do not reach for any object that is up high or over far. Get your body close to the object to be lifted. If it is up high, get on a ladder. (Use the proper method of climbing a ladder. See the Safety Module.)

4. Keep your back straight. Line up your back so you don't strain it. Bend at the knees and hips--NOT the back.

5. As you lift, straighten your legs. When you bend to lift something, bend your knees. To lift it, straighten your legs.

6. If you need to turn, shift the position of your feet, but do NOT turn your body. Twisting injures muscles.

7. If you are lifting with someone, lift smoothly. This avoids strain on your back which you would get from jerky movements. Count with the person to make sure the lift is smooth.

8. Push or pull a heavy object whenever possible. It is easier and safer.

9. Remember to use these skills all of the time to keep yourself safe.

HEATING, AIR CONDITIONING AND REFRIGERATION

Aptitudes - indicates an ability to:

perceive pertinent detail in objects in pictorial or graphic material (P-form perception)
make visual comparisons and discriminations and see slight differences (P-form perception)
coordinate eyes and hands or fingers rapidly and accurately (K-motor coordination
make a movement response accurately and swiftly (K-motor coordination)
move the fingers and manipulate small objects with the fingers, rapidly or accurately (F-finger dexterity)
move the hands easily and skillfully (M-manual dexterity)
work with the hands in placing and turning motions (M-manual dexterity)

1. Given worksheets with electrical diagrams student will identify the one that is different by circling the area of difference. See worksheet AC/R #5.

2. Given a worksheet with drawings of symbols used in the field student will match all like pairs. See worksheet AC/R #6.

3. Using worksheet AC/R #7 student will identify symbols on diagrams of worksheet AC/R #8 by labeling.

4. Given small components from an air conditioning business, student will disassemble and re-assemble with increasing speed. A shop teacher should be able to supply small engines, or components of motors or other similar electrical items for assembly. A local air conditioning or refrigeration firm may also be willing to supply small components. If an old window air conditioner can be found and a diagram located (from the manufacturer) student could tear it down and put it back together.

5. Student will practice reflex actions by catching small items as they are pushed off the side of a table by teacher.

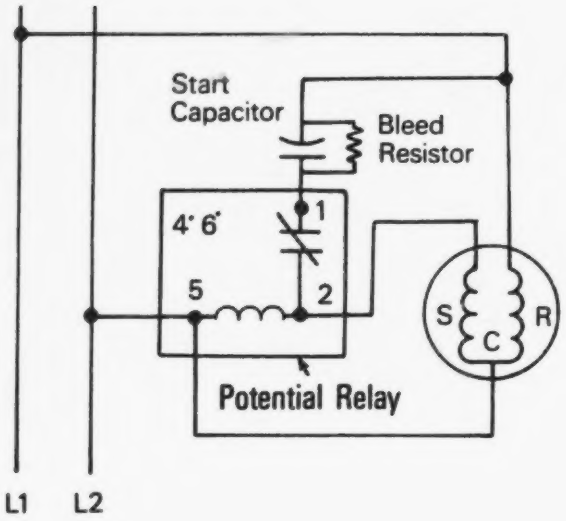
SUGGESTIONS FOR PARENTS:

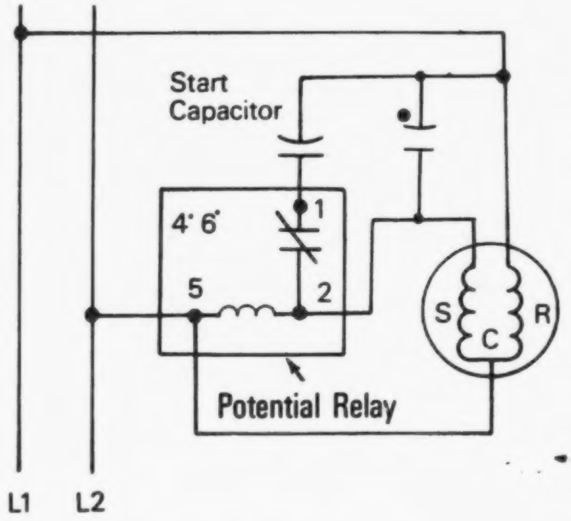
1. Provide student with a screw driver and have him/her tighten screws around the house.

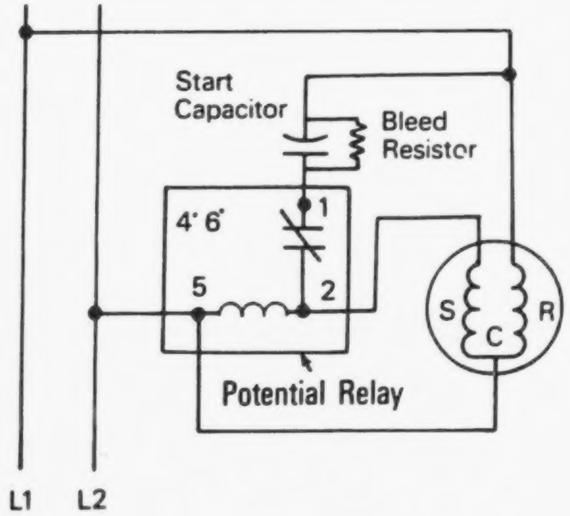
2. Have student organize home workshop or bench especially putting all small items such as screw, nails, bolts etc. into separate containers by size.

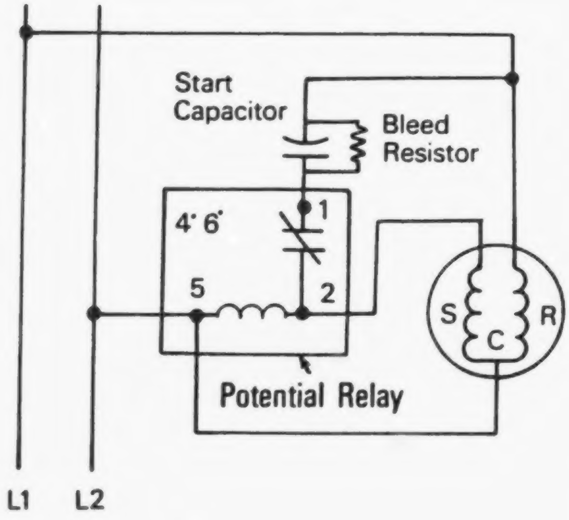
WORKSHEET

Below you will find four diagrams. Circle the one that is different. Put an "X" on the parts that make the diagram different.


Start
Capacitor
Bleed
Resistor
4' 6'
1
5
2
S
C
R
Potential Relay
L1
L2


Start
Capacitor
4' 6'
1
5
2
S
C
R
Potential Relay
L1
L2

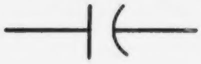

Start
Capacitor
Bleed
Resistor
4' 6'
1
5
2
S
C
R
Potential Relay
L1
L2

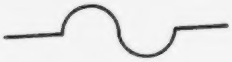

Start
Capacitor
Bleed
Resistor
4' 6'
1
5
2
S
C
R
Potential Relay
L1
L2

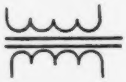
AC/R #6

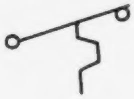
WORKSHEET

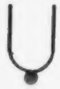
Draw a line matching the symbols on the left with the symbols on the right.

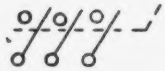
1. 

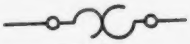
2. 

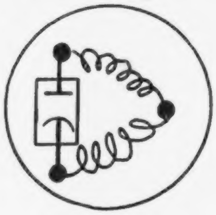
3. 

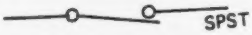
4. 

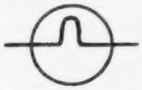
5. 

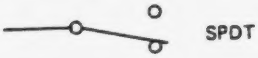
6. 

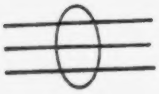
7. 

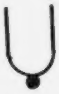
8. 

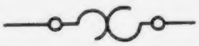
9. 

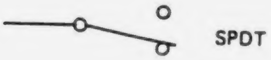
10. 

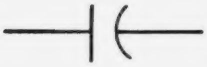
11. 

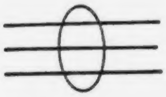
12. 

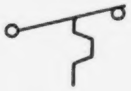
1. 

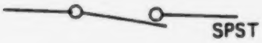
2. 

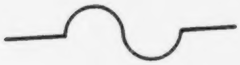
3. 

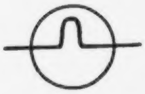
4. 

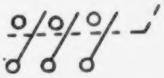
5. 

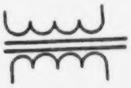
6. 

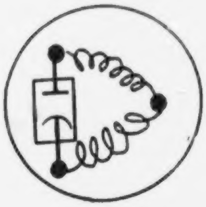
7. 

8. 

9. 

10. 

11. 

12. 

WORKSHEET

Using worksheet #8 as your guide, write the name of the symbol shown below.

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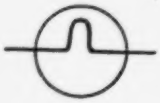
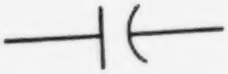
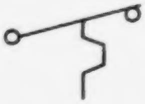


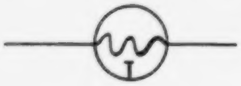
2. ______________________________



3. ______________________________



4. ______________________________



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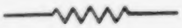

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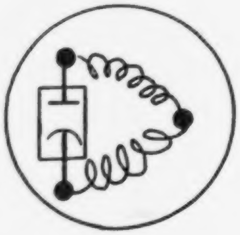
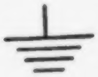
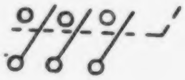


7. ______________________________



8. ______________________________



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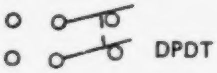

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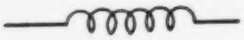

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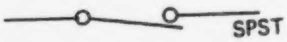

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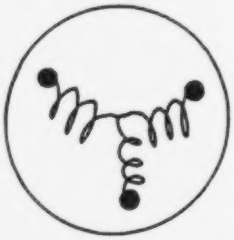
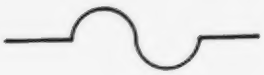


AC/R #7 (continued)

13. ____________________



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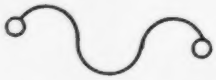

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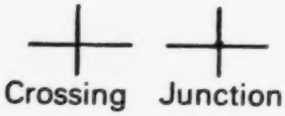
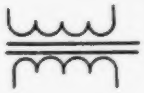
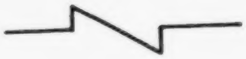

Crossing
Junction

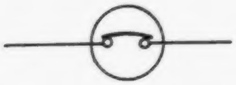
16. ____________________



17. ____________________



18. ____________________



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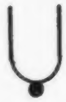

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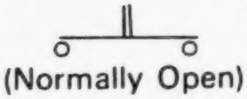
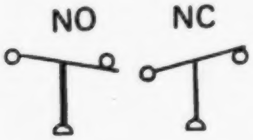
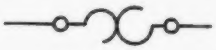

(Normally Open)

21. ____________________



22. ____________________



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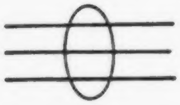
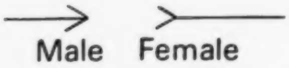
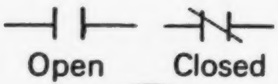


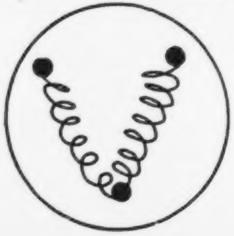
24. ____________________


Male
Female

25. ____________________

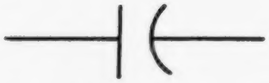

Open
Closed

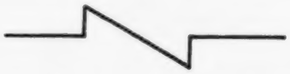
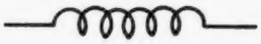
26. ____________________

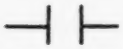
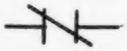


WORKSHEET

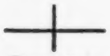
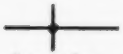
SYMBOL INFORMATION SHEET

A. Capacitor 

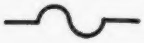
B. Coils  

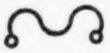
C. Contacts  

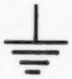
Normally Open (N.O.) Normally Closed (N.C.)

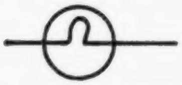
D. Conductors  

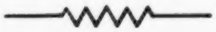
Crossing Junction

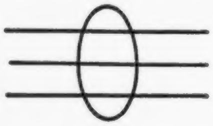
E. Fuse 

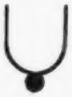
F. Fusible link 

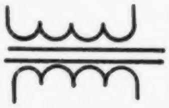
G. Ground connection 

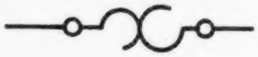
H. Light 

I. Resistor or resistance heater 

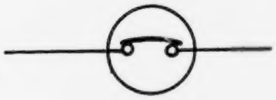
J. Multiple conductor cable 

K. Thermocouple 

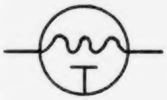
L. Transformer 

M. Thermal overload 

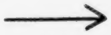
N. Bimetal switch



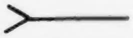
O. Thermistor



P. Connectors

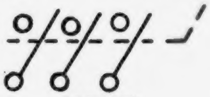


Male

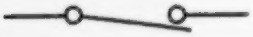


Female

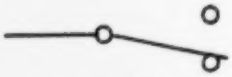
Q. Switches disconnect



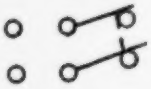
R. Single pole single throw (SPST)



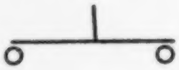
S. Single pole double throw (SPDT)



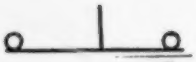
T. Double pole double throw (DPDT)



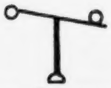
U. Push button (normally open)



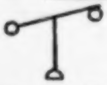
V. Push button (normally closed)



W. Pressure switches

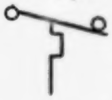


Opens on Pressure Rise

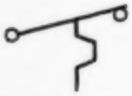


Opens on Pressure Drop

X. Temperature switch

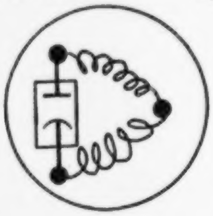


Close on Rise

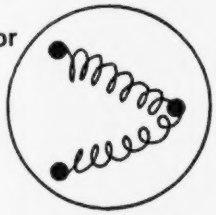


Open on Rise

Y. Permanent split capacitor motor



Z. Single-phase motor



Temperament - indicates an ability to adapt to:

making generalizations, evaluations, or decisions based on measurable or verifiable criteria
situations requiring the precise attainment of set limits, tolerances, or standards

1. Given a variety of sets of choices between items to use or things to do for a variety of jobs student will select one choice and state rationals for the choice. For example, show student a hammer and a wire cutter, ask which one of them he/she would use to remove a nail from a board, or ask what he/she would do if they saw a live wire lying in water - 1) pull it out of the water, or 2) turn off the main source of power and call the fire station.

2. Given a shopping list of tools and other items relating to air conditioning and refrigeration (air conditioner, motors etc.) student will use a Sears or Penney's catalog - locate item and fill out the order form with correct ordering information.

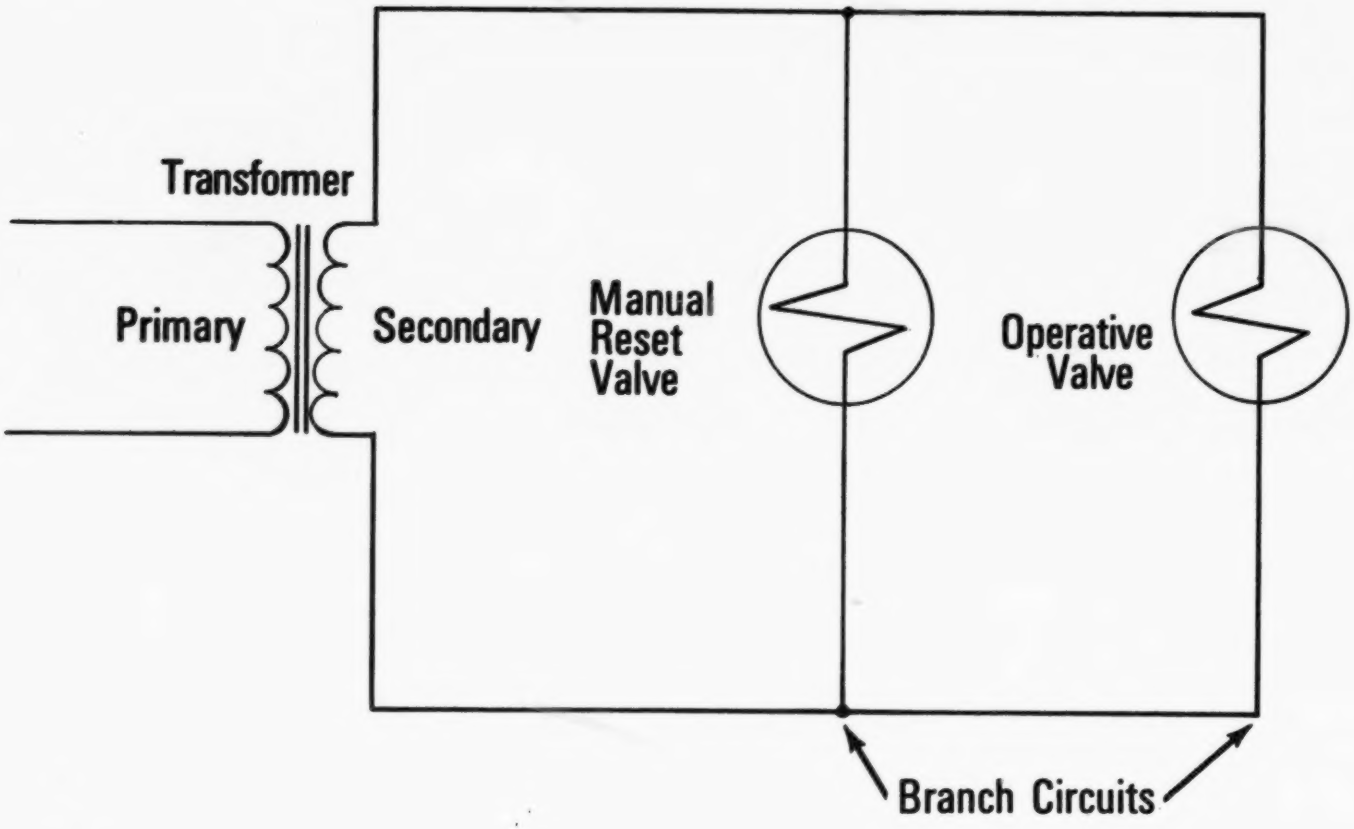
3. Using worksheet AC/R #9 student will duplicate drawing. Student may use tracing paper or graph paper but it must be an accurate reproduction.

SUGGESTIONS FOR PARENTS:

1. Ask student to develop a checklist of steps to be followed in doing a specific job around the home.

2. Give student a shopping list with specific requirements. If the student purchases an item not meeting the requirements have him/her list at least three reasons why he/she purchased the one item over the other.

Parallel Circuit


Transformer
Primary
Secondary
Manual Reset Valve
Operative Valve
Branch Circuits

AC/R # 9

HEATING, AIR CONDITIONING AND REFRIGERATION

Vocational

Identify basic hand tools and equipment
Use basic hand tools and equipment
Demonstrate knowledge of basic safety concepts

1. See instructional module on identifying and using basic hand tools.
2. See instructional module on safety and first aid.
3. Student will identify safety hazards associated with working with electricity and small motors. Have student interview vocational instructors and/or business people.

SUGGESTIONS FOR PARENTS:

1. Have student arrange tools in parents work area.
2. Have student demonstrate to parents ability to use tools in the home.
3. Have student put together a first aid kit for the home.

RESOURCES

HEATING, AIR CONDITIONING AND REFRIGERATION

American Technical Publishers, Inc.
1155 West 175th Street
Homewood, IL 60430

Basic Blueprint Reading: Residential, Putnam, R.

Mid-America Vocational Curriculum Consortium, Inc.
1500 West Seventh
Stillwater, OK 74074

Electrical Components and Systems, Wantrez, G.
Air Conditioning and Refrigeration, Eckes, W., & Fulkerson, D.

OFFSET LITHOGRAPHY/PRINTING OCCUPATIONS

Sample Occupational Areas:
- Collator Operator
- Offset Press Operator Apprentice
- Photographer, Lithographic
- Print Shop Helper

Introduction

An individual interested in the occupation of offset printing will be concerned with writing or printing on flat surfaces. A wide range of occupational opportunities exist. Someone who is creative in nature may work with layout and design or paste-up of materials. Another who prefers specific set standards may be best suited to work as a proofreader.

Companies that employ offset printers include commercial printing plants, newspapers, book publishers, advertising agencies and binding companies as well as speciality shops such as design or composition shops.

Among the personal traits expected of an individual in this field are the ability to listen to and follow instructions well, ability to accept constructive criticism, to work well with others as well as some mechanical ability.

Offset printers are expected to operate printing equipment well, work with accuracy, speed and neatness, have a desire for perfection and the ability to work without direct supervision.

An individual considering this occupation will find an open job market in a rapidly growing industry, comfortable indoor working conditions and a variety of challenging tasks. Also to be considered are the close work, confinement, pressure of work deadlines, rigid standards for accuracy, long hours during peak production periods and the probability that most good employment opportunities are confined to metropolitan areas.

VIMS COMPETENCIES FOR OFFSET LITHOGRAPHY/PRINTING OCCUPATIONS

A. Processing Job Orders

1. Check specifications and planning
2. Estimate job costs (space and utilities, labor, and supplies)
3. Compute customer's cost (planning, scheduling)

Other (specify):

____

____

____

B. Prepare Customer Layouts

1. Prepare a rough layout
2. Indicate how photographs and headings are to be printed for layout person
3. Indicate percentage of enlargement or reduction required on photos
4. Indicate typefaces and point sizes to be used in typesetting
5. Make dummy layout of multipage printed product for signature specifications
6. Place crop marks on pictures
7. Produce a comprehensive layout
8. Revise layout to customer specifications
9. Secure photocopied galley proofs in position on comprehensive layout
10. Sketch proposed customer's rough layout

Other (specify):

____

____

____

C. Typesetting

1. Justify copy on an impact machine
2. Make heading using press types
3. Make headlines with display typesetter
4. Program and type copy on a photographic input composition machine
5. Process photographic composition galley pages using processor
6. Make photocopies of galleys
7. Proofread all galley copy
8. Code for corrections
9. Distribute corrected proofs to copy (to proper departments)
10. Read and compare type composition against customer-approved comprehensive layout
11. Code for typestyles, leading, line length and point sizes
12. Read and compare final layout against customer-approved comprehensive layout
13. Set type using hand-set type method
14. Make up jobs with machine set type

Other (specify):

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D. Producing Camera Ready Copy and Mechanicals

1. Draw up base sheet for final paste-up
2. Trim galley sheets
3. Apply adhesives (rubber cement, wax, tape)
4. Check all proportions and sizes with job requirement
5. Crop and size all photographs
6. Use diffusion transfer process to make enlargements or reductions
7. Trim prescreened photographs
8. Keyline pictures
9. Place all illustrations and typed matter in position on base sheet (paste-up)
10. Make alterations on existing photographs
11. Locate and use clip-art
12. Apply dry transfers (lettering, screens)
13. Cut panels for halftones and reverses
14. Cut masking film for multicolor overlays
15. Position and secure overlays and tissues
16. Compare artwork to customer-approved comprehensive layout
17. Check camera-ready copy for photo reproduction quality
18. Photocopy page proofs
19. Return paste-up with corrections marked to composition if required

Other (specify):

____

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E. Exposing with a Camera

1. Clean and maintain gallery and darkroom
2. Sort work to be photographed into line copy, halftone copy and color copy
3. Make exposure tests (line exposure)
4. Use camera filters if necessary for appropriate color copy
5. Expose line work with line film
6. Determine basic density range of screen
7. Determine density range of continuous tone copy with densitometer or gray scale
8. Determine exposure through use of Kodak (negative halftone) computer
9. Make exposure with computer integrated system and/or time system
10. Expose photograph using contact halftone screen
11. Use rapid access materials
12. Use duplicating film for line work

Other (specify):

____

____

____

F. Processing Film and Printed Material

1. Mix processing chemicals
2. Develop film to proper density by time and temperature methods
3. Develop film to proper density by gray scale method
4. Develop film to proper density by visual method
5. Dry film
6. Inspect negative for quality and density

7. Run and evaluate test strip from automatic film processor
8. Process negative through automatic film processor
9. Inspect negatives for density, quality and size
10. Process rapid access materials in tray or rapid access processor

Other (specify):

G. Contacting

1. Make exposure tests on a contact frame with duplicating and contact film
2. Make a contact print or positive by the contact method
3. Expose for reverse choke and spreads by contact printing
4. Expose combination negatives with pin register by contact printing
5. Use of daylight contacting and duplicating films

Other (specify):

H. Performing Image Assembly Operation

1. Use the register punch system for multiple exposure
2. Opaque negative imperfections
3. Tape down a masking sheet to a light table
4. Draw all reference and centering lines on the masking sheets
5. Check negatives against dummy layout
6. Lay negatives in position on flat (imposition) and tape
7. Open all areas of material to be printed
8. Scribe lines if necessary
9. Tape halftones and screen tints
10. Angle screens
11. Strip for double burns using pin register
12. Cut Rubylith for color separations
13. Add registration marks and trim marks
14. Inspect finished flat for accuracy
15. Check flat against copy and dummy layout

Other (specify):

I. Proofing

1. Make a silverprint or blueline proof in a vacuum frame
2. Use Dylux, dry proofing system
3. Use overlay proofing system (by hand and/or machine)
4. Use powdered toning proofing system (chromolin)
5. Use laminated proofing system
6. Run press proofs
7. Check proofs under proper lighting conditions
8. Show proofs to customers
9. Strip changes and corrections into flat
10. Make revised proofs

Other (specify):

J. Making Plates

1. Check flat for imperfections, scratches, block images and imposition
2. Position flat on top of plate in register in vacuum frame
3. Expose plate for predetermined time
4. Expose all additional masks or multiple burns required for each plate
5. Process additive plate by hand
6. Process subtractive plate by hand
7. Feed plate through automatic developer or processor
8. Dry plate with clean cloth
9. Make deletions and additions
10. Inspect plate for accuracy and quality
11. Preserve plate for future use
12. Orientation to photo-direct platemaker
13. Make a plate with a photo-direct platemaker
14. File flats and plates in proper areas

Other (specify):

K. Press Operation

1. Put dampeners in press
2. Change and/or adjust feeder and delivery for different sheets
3. Air, jog and condition paper
4. Load stock into press feeder
5. Mount plate on press
6. Adjust impression to caliper of paper
7. Feed paper through press and set all guides
8. Measure and mix dampener fountain solution
9. Put dampener fountain solution in press
10. Ink up press
11. Clean gum off metal plate with water
12. Square image up on paper
13. Approve press set-up for position
14. Adjust and maintain color
15. Adjust color head (lateral adjustment) to match up with first head if two-color job
16. Maintain register
17. Correct for washed-out and/or over-inked copy
18. Use reflection densitometer to get uniform ink coverage
19. Wipe off particles of dust or dried ink (hickies) from plate
20. Perforate and score on press
21. Maintain pH in fountain solution (conductivity)
22. Test water in press regularly with litmus paper
23. Run solid color straight through
24. Run two-color line work
25. Run four-color separations
26. Pull progressive proofs
27. Set gauge for spray powder

28. End run
29. Unload stock
30. Remove plate
31. Wash up press
32. Change roller covers
33. Repair electrical malfunctions
34. Repair mechanical malfunctions
35. Lubricate press
36. Clean press
Other (specify):

L. Finishing Operations

1. Jog paper manually or by machine
2. Jog paper on table model jogger
3. Jog large sheets of paper
4. Prepare cutting layouts
5. Make cuts according to cutting sequence or other instructions given
6. Cut paper with single-knife hydraulic paper cutter
7. Cut paper with fully automatic three-knife book trimmer
8. Cut paper with table-top bar paper cutter
9. Cut paper with cornering machine
10. Set folder according to imposition dummy (discuss folders)
11. Perforate with wheel attached to delivery end of paper folder
12. Perform saddle-wire binding (wire staple)
13. Perform side-wire binding (wire staples)
14. Perform perfect binding
15. Perform thermal binding
16. Perform case binding (hard and soft)
17. Perform ring binding (loose-leaf)
18. Perform postbinding (loose-leaf)
19. Perform spiral wire binding (mechanical)
20. Perform plastic cylinder binding
21. Perform padding
22. Pad carbonless stock
23. Trim job after binding
24. Drill stock
25. Gather and collate by hand and machine
26. Perforate with pin bar on special machine to punch holes in sheet
27. Perforate using rotary perforating machine
Other (specify):

M. Paper Handling

1. Receive paper, check invoices and store
2. Handle paper without damaging, spilling or shifting its load in stock
3. Count paper (inventory)
4. Transport paper, manually or otherwise
Other (specify):

N. Packaging and Preparing for Mailing

1. Perform heat shrink wrapping
2. Wrap package with Kraft paper
3. Wrap packages with cello and tape
4. Box completed job
5. Label ends of boxes
6. Band packages
7. Address labels on package
8. Weigh letters or packages on postal scale to determine mailing costs
9. Sort mail by zip code
10. Apply labels - manually or automatically
11. Mail letters or packages
12. Make deliveries to local customers
Other (specify):

O. Performing Specialty Operations

1. Use + and - bimatic numbering machine or platen cylinder press
2. Perform die cutting operation on a standard letterpress machine
3. Perform die cutting operation on heavy-duty die cutting machine
4. Laminate materials
5. Preventive maintenance
Other (specify):

Leadership Competencies **

1. Demonstrate an understanding of VICA, its structure and activities
2. Demonstrate an understanding of one's personal values
3. Perform tasks related to effective management skills
4. Demonstrate interpersonal skills
5. Demonstrate etiquette and courtesy
6. Demonstrate effectiveness in oral and written communications
7. Develop and maintain a code of professional ethics
8. Maintain a good professional appearance
9. Perform basic tasks related to securing and terminating employment
10. Perform basic parliamentary procedures in a group meeting

** (Note: These competencies are addressed in the Missouri VICA Curriculum Guide lessons.)

OFFSET LITHOGRAPHY/PRINTING OCCUPATIONS
ACCESS SKILLS CHECKLIST

Student Name/ID ______________________ Sending School ______________________

Instructor ______________________ Date(s) Evaluated ______________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
1 = NOT MASTERED N or blank = NO EXPOSURE

TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
1. Count two-place numbers	480299A001	3 2 1 N	________	________
2. Add two-place numbers	480299A002	3 2 1 N	________	________
3. Subtract two-place numbers	480299A003	3 2 1 N	________	________
4. Perform standard units of measurement, i.e., cup, pint, quart, inch, foot, yard, ounce, pound	480299A004	3 2 1 N	________	________
5. Use basic measuring instruments, i.e., rulers, scales	480299A005	3 2 1 N	________	________
6. Multiply two-place numbers	480299A006	3 2 1 N	________	________
7. Divide two-place numbers	480299A007	3 2 1 N	________	________
8. Add common fractions	480299A008	3 2 1 N	________	________
9. Subtract common fractions	480299A009	3 2 1 N	________	________
10. Multiply common fractions	480299A010	3 2 1 N	________	________
11. Divide common fractions	480299A011	3 2 1 N	________	________
12. Add two-place decimals	480299A012	3 2 1 N	________	________
13. Subtract two-place decimals	480299A013	3 2 1 N	________	________
14. Multiply two-place decimals	480299A014	3 2 1 N	________	________
15. Divide two-place decimals	480299A015	3 2 1 N	________	________
16. Lift 20 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 10 lbs. (light work)	480299B001	3 2 1 N	________	________
17. Extend the hands and arms in any direction (reaching)	480299B002	3 2 1 N	________	________
18. Seize, hold, grasp, turn or otherwise work with the hand or hands (handling)	480299B003	3 2 1 N	________	________
19. Pick, pinch, or otherwise work with the fingers (fingering)	480299B004	3 2 1 N	________	________
20. Perceive size, shape, temperature or texture of objects and materials by using fingertips (feeling)	480299B005	3 2 1 N	________	________
21. Ability to work inside	480299B006	3 2 1 N	________	________
22. Think visually of geometric forms atial)	480299C001	3 2 1 N	________	________
23. Comprehend the two dimensional representation of three-dimensional objects (S-spatial)	480299C002	3 2 1 N	________	________
24. Recognize the relationship resulting from the movements of objects in space (S-spatial)	480299C003	3 2 1 N	________	________

OFFSET LITHOGRAPHY/PRINTING OCCUPATIONS
ACCESS SKILLS CHECKLIST

Student Name/ID ______________________ Sending School ______________________

Instructor ______________________ Date(s) Evaluated ______________________

Circle proper mastery code: 3 = MASTERY 2 = REQUIRES SUPERVISION
1 = NOT MASTERED N or blank = NO EXPOSURE

TASK DESCRIPTION	TASK ID #	MASTERY CODE	MASTERY DATE	RETRY CODE/DATE
25. Perceive pertinent detail in objects in pictorial or graphic material (P-form perception)	480299C004	3 2 1 N		
26. Make visual comparisons and discriminations and see slight differences (P-form perception)	480299C005	3 2 1 N		
27. Coordinate eyes and hands or fingers rapidly and accurately (K-motor coordination)	480299C006	3 2 1 N		
28. Make a movement response accurately and swiftly (K-motor coordination)	480299C007	3 2 1 N		
29. Move the hands easily and skillfully (M-manual dexterity)	480299C008	3 2 1 N		
30. Work with the hands in placing and turning motions (M-manual dexterity)	480299C009	3 2 1 N		
31. Match or discriminate between colors	480299C010	3 2 1 N		
32. Identify a particular color or color combination	480299C011	3 2 1 N		
33. Perceive contrasting color combinations	480299C012	3 2 1 N		
34. Making generalizations, evaluations, or decisions based on measurable or verifiable criteria	480299D001	3 2 1 N		
35. Situations requiring the precise attainment of set limits, tolerances, or standards	480299D002	3 2 1 N		
36. Demonstrate knowledge of basic safety concepts	480299E001	3 2 1 N		

OFFSET LITHOGRAPHY VOCABULARY

BALANCE	pleasing arrangement of elements on a page
CLIP ART	material, such as illustrations, letters, and designs, clipped form available sources and utilized as camera copy
COLOR TONE	the lightness or darkness of a color
COMPREHENSIVE LAYOUT	accurate representation of final printed product
COPYFITTING	the process of finding out how much space is needed to print the words in a job
CROPPING	eliminating part of the copy
DUMMY	a pattern arrangement of the materials to be printed
ELEMENT	each individual portion of the printed message, for example: a heading, an illustration, a paragraph, a footnote, a decoration, a photograph
EMPHASIS	arrangement of elements on a page to attract most attention to the most important element
FITNESS	physical appropriateness of type and paper to the printed message
HALFTONE ILLUSTRATION	a kind of copy (usually pictures) which has gradation or variation of tone; that is, it contains not only black and white tones, but appears to have shades of gray between them
HUE	one color added to another color
INTENSITY	the full strength or purity of a color
JUSTIFIED	all lines of typeset copy are even on both sides (flush left and flush right)
LAYOUT	the plan of any piece to be printed
LEADING	the space between lines of type
LINE ILLUSTRATION	drawing that is black and white, without shades of gray
LOWER CASE	small, non-captial letters only
MEASURE	the width of a line of type

PASTE-UP	a sheet on which all the reproduced elements of the final product are pasted, in proper size and location, just as the comprehensive layout indicates
PRIMARY COLOR	one which cannot be made by mixing other colors
PROPORTION	pleasing arrangement of margins, page sizes, and shapes
RELIEF TYPE	characterized by surface inequalities, such as the inked, raised letters in letterpress printing
RHYTHM	leads the reader's eye in the desired direction and draws attention to various elements of the design
ROUGH LAYOUT	an actual size, somewhat more refined version of the thumbnail sketch
SCALING	amount of enlargement or reduction of copy
SHADE	black added to a color to make it darker
SHAPE HARMONY	compatibility of all the elements on a page
STRIKE-ON TYPE	any type that has been placed on copy by the means of a key or font containing the characters striking paper
THUMBNAIL SKETCH	one of several small, crude drawings which shows a possible way to combine various elements of a printed product
TINT	white added to a color to make it lighter
TONE	psychological appropriateness of type and paper to the printed message
TYPE	one or more printed characters
UPPER CASE	capital letters only

TOOLS AND EQUIPMENT FOR OFFSET LITHOGRAPHY

Black ink

Blue pencil

China marking pencil

Cotton pads

Illustration board

Ink knife

Layout table

Line gauges

Magnifier

Masking/drafting tape

Offset plate

Opaquing brush

Photolettering/phototypesetting machine

Phototypesetting machine

Plastic triangles

Preservatives

Proportion wheel

Rubber cement

Ruby film material

Ruler

Scissors

Solvents

Stripping knife

T-square

Tape dispenser

Trimboard

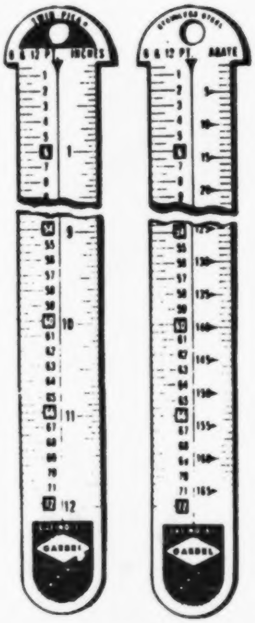
Type image carrier

Typesetting machine

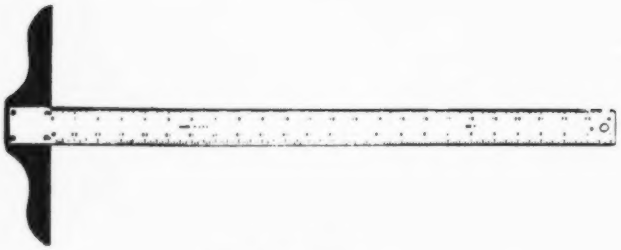
Water bottle

White paper

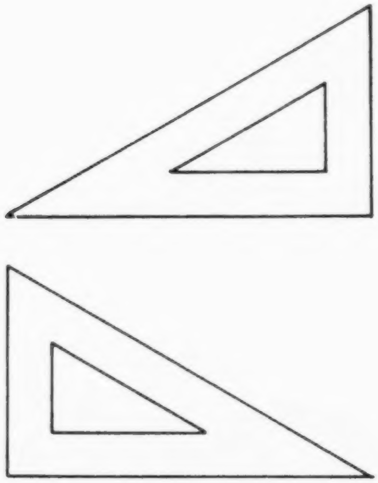
Basic Hand Tools



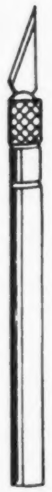
Line Gauges



T- Square



Plastic Triangles



Stripping Knife

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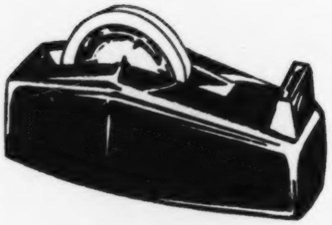
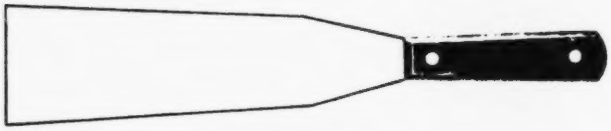
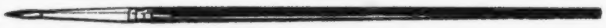
Basic Hand Tools
(Continued)



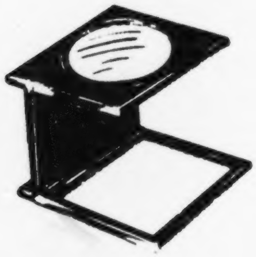
Tape Dispenser



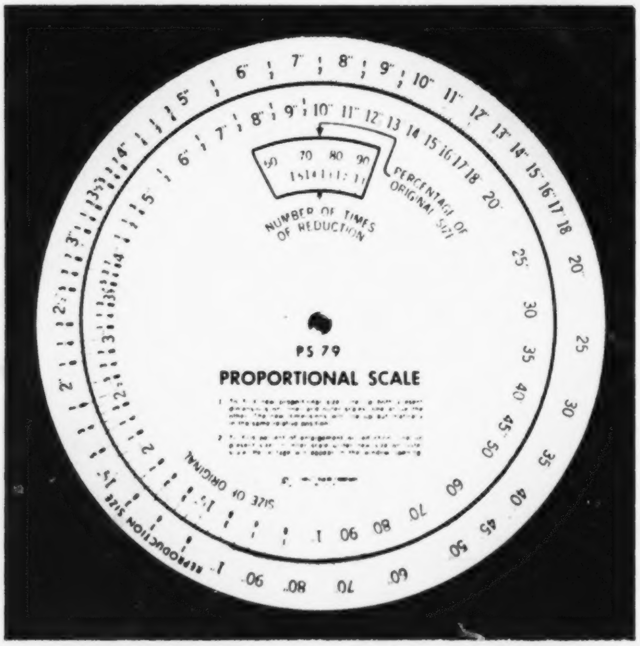
Ink Knife



Opaquing Brush



Magnifier


PERCENTAGE OF ORIGINAL SIZE
NUMBER OF TIMES OF REDUCTION
PS 79
PROPORTIONAL SCALE
SIZE OF ORIGINAL
REPRODUCTION SIZE

Proportion Wheel

Tarajollohi, Reed, Woodcock, pg. TM3

OFFSET LITHOGRAPHY

Math Skills

Count two-place numbers
Add two-place numbers
Subtract two-place numbers
Perform standard units of measurement
  i.e., cup, pint, quart, inch, foot,
  yard, ounce, pound
Use basic measuring instruments,
  i.e., rulers, scales
Multiply two-place numbers
Divide two-place numbers
Add common fractions
Subtract common fractions
Multiply common fractions
Divide common fractions
Add two-place decimals
Subtract two-place decimals
Multiply two-place decimals
Divide two-place decimals

NOTE: Many math books and workbooks provide needed direction in learning basic operations in math. This section assumes that students have basic skills and is designed to be used in conjunction with any of the math books you might be using, or to establish your own supplemental units. Any math practice activities should be developed within the context of the vocational program. Other persons to use as resources in this area include: parents, math teacher, and vocational instructor for this and related areas.

General information from all areas:

1. Given a group of pictures taken from magazines student will measure pictures so they may be layed out on 8 1/2 x 11 and 8 1/2 x 14 sheets of paper in order with equal spaces between pictures and with a 1 or 1/2 inch border. Only one picture needs to be put on a paper or 2-3 pictures can be placed on the paper. The student needs to use a ruler and draw guide lines using a blue pencil to ensure even spacing as well as straightness of pictures.

2. Given several sizes of paper student will divide some into thirds, halves, forths, and sixths. The student must measure the width and/or length and then divide by the appropriate fraction.

3. Student will perform ratio mixing of liquids. Given 6 sets of containers with labels of chemicals on each and filled with colored water have the student mix the sets according to teacher direction. For example, sets might be chloride acid and ink removal. The student would be asked to mix those two on a 3 to 2 basis in a third empty container. They should be able to repeat how many equal measures they took from each container.

4. Given a variety of mail, in terms of weight, student will determine weight on a postage scale and the cost to mail package according to current postage rates.

5. Given a large number of used envelopes from a wide area student will sort mail according to zip codes.

SUGGESTIONS FOR PARENTS:

1. Have student arrange the addresses in the family address book according to states and zip code.

2. Allow student to participate when mixing lawn chemicals or preparing recipes to develop greater understanding of measurements and ratios.

OFFSET LITHOGRAPHY

Physical Demands/Working Environment

Lift 20 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 10 lbs. (light work)
Extend the hands and arms in any direction (reaching)
Seize, hold, grasp, turn or otherwise work with the hand or hands (handling)
Pick, pinch, or otherwise work with the fingers (fingering)
Perceive size, shape, temperature or texture of objects and materials by using fingertips (feeling)
Ability to work inside

In most cases, the assessment of these skills will indicate that the student has the gross and fine motor skills which are prerequisites to learning the vocational skills in an Offset Lithography program. Prior to instruction in any physical demands activities, the student should have been evaluated and parents contacted to make sure that the student has no hidden physical problems that could be aggravated by lifting objects or by other physical activities done in this area. However, if the student has a physical disability or other limitation(s) preventing him/her from demonstrating fine and gross motor skills, then other techniques may be taught so he/she can perform in the vocational program. Other persons to use as resources in this area include: physical education teacher, industrial arts teacher, special education teacher, and parents.

1. For teaching instruction please refer to instructional module on the use of proper lifting methods at the end of this manual.

2. Student will demonstrate proper lifting techniques by lifting, carrying and putting down stacks of books, magazines and reams of paper weighing up to 10 lbs.

3. Student will list the types of reaching activities performed by persons in the offset printing occupation by watching students in the local area vocational program or in a local printing shop.

4. Given three sets of pictures and three pieces of paper with boxes drawn into areas matching each picture set the student will match the picture to the appropriate box, tack the picture down with two sided tape into the center of the box and then scotch tape all four sides down totally.

5. Given a 3 line poem or saying and using a real or toy type letter set student will place the letters into words in the type set holder. The local area vocational school should be able to provide small print holder boxes as well as old type set letters. If not, small toy sets are available in toy stores. A small set would prove valuable in further training and experience. If nothing is available, small wooden cubes with individual letters may be used, such as and old

scrabble set. This allows the student to use fingering, handling and perception ability.

6. Given cups (at least 3) filled with varying thicknesses of a substance (from very thick and gooey, to thin and runny) the student will identify, by feel, the degree of thickness.

7. Student will use a paper cutter to make at least 10 sheets of paper 10 specified sizes.

8. Given a large number of mailing labels student will affix labels to envelopes.

9. Student will assist teacher in organizing materials by labeling ends of boxes according to content.

SUGGESTIONS FOR PARENTS:

1. Have student demonstrate proper lifting techniques to the family.

2. Have student put favorite recipes into a three ring binder. The recipes should be places on 8 x 11 sheets of paper or plastic inserts in a pleasing manner. Have student find appropriate headings and mount them on title pages along with any appropriate pictures.

OFFSET LITHOGRAPHY

Aptitudes - Indicates an ability to:

think visually of geometric forms (S-spatial)
comprehend the two dimensional representation of three-dimensional objects (S-spatial)
recognize the relationship resulting from the movements of objects in space (S-spatial)
perceive pertinent detail in objects in pictorial or graphic material (P-form perception)
make visual comparisons and discriminations and see slight differences (P-form perception)
coordinate eyes and hands or fingers rapidly and accurately (K-motor coordination)
make a movement response accurately and swiftly (K-motor coordination)
move the hands easily and skillfully (M-manual dexterity)
work with the hands in placing and turning motions (M-manual dexterity)
match or discriminate between colors
identify a particular color or color combination
perceive contrasting color combinations

1. Student will create a bulletin board using three different letter print types.

2. Student will make a notebook of print types that demonstrate a tone (formal, strong and powerful, light and airy). The use of a wide variety of magazine and newspaper articles will help student complete this objective.

3. Using a variety of borders and print styles student will make a picture appear forceful, then soft and then very formal in style. Any picture found in a magazine can be used. The student can change the border and print style to get different meanings across.

4. Student will make pictures on T-shirts, skirts or scarves by cutting designs into linoleum blocks and dipping the blocks into dye and then onto material. The assistance of the art teacher may be needed for this exercise.

5. Student will transfer lettering and/or designs onto paper, skirts, T-shirts other wearing apparel using a silk screening technique. The assistance of the art teacher may be needed for this task.

6. Student will learn basic principles and application of typing. The Access Skills: Business and Office Vocational Readiness Skills has a module on typing that would be useful to teach a student this skill. The assistance of the typing teacher in the student's school would also be helpful.

7. Student will learn to use copy machine including reducing and enlarging materials.

8. Student will recognize colors in relation to primary, secondary, contrasting and harmonizing. For further instruction refer to the module on colors in this manual.

9. Student will use letter blocks from scrabble game to spell out sentences and phrases provided by teacher.

SUGGESTIONS FOR PARENTS:

1. Have student design a letterhead for home stationary and then silk screen the design onto stationary.

OFFSET LITHOGRAPHY

Temperament - Indicates an ability to adapt to:

making generalizations, evaluations or decisions based on measurable or verifiable criteria
situations requiring the precise attainment of set limits, tolerances, or standards

1. Given a paragraph on student's reading level he/she will proofread for errors using the printers proofreading marks. See worksheets OL #1 and #2.
2. Have student organize a desk for maximum useability and workspace. If there is no desk space available have student organize a box or an area that contains materials needed for desk type work, such as tape, pencils, writing pads etc. It should be the student's responsibility to keep the area or box neat and organized.
3. Student will complete an assignment that requires placing pictures, lettering and borders in specific places on paper.
4. Student will conduct an ad design contest in the school or classroom setting up specific criteria. Student will judge the ads and give reasons, based on set criteria, for selection of the top 3 ads.
5. Student will select two favorite ads (one formal, one humorous), from two of three magazines and tell why the two were selected based on placement of material on the paper, color and lettering used.

SUGGESTIONS FOR PARENTS:

1. Ask student to tell parent(s) why pictures and/or decorations in his/her room are placed the way they are.
2. Have student rearrange room and tell why the new arrangement was selected.

WORKSHEET OL #1

PROOFREADERS MARKS

₰	Delete	\em|	Em dash
⌢₰⌣	Delete and close up	|en|	En dash
9	Turn inverted letter	;/	Insert semicolon
⌢⌣	Close up	:/	Insert colon
#	Insert space	⊙	Insert period
✓✓✓	Equalize spacing	?/	Insert question mark
less #	Reduce spacing	?⃝	Query to author
¶	Paragraph	⌢	Use ligature
□	Indent one em	SP⃝	Spell out
[	Move to left	tr	Transpose
]	Move to right	Set 1, 2, 3,	In this order
⊔	Lower	wf	Wrong font
⊓	Elevate	bf	Set in bold face type
∧	Insert marginal addition	rom	Set in roman type
×	Broken letter	ital	Set in italic type
⊥	Push down space	Caps	Set in capitals
=	Straighten	sc	Set in small captials
||	Align type	lc	Set in lower case
$\underset{,}{\wedge}$	Insert comma	B̸	Lower-case letter
$\overset{\prime}{\vee}$	Insert apostrophe	Stet	Let it stand
$\overset{\prime\prime}{\vee}$	Insert quotes	no ¶	Run in same paragraph
(/)	Insert parentheses	ld>	Insert lead between lines
[/]	Insert brackets	hr #	Hair space between letters
$\underset{3}{\wedge}$	Insert inferior figure	Out sc	Out-see copy
$\overset{3}{\vee}$	Insert superior figure	##	End of copy
=/	Hyphen		

WORKSHEET

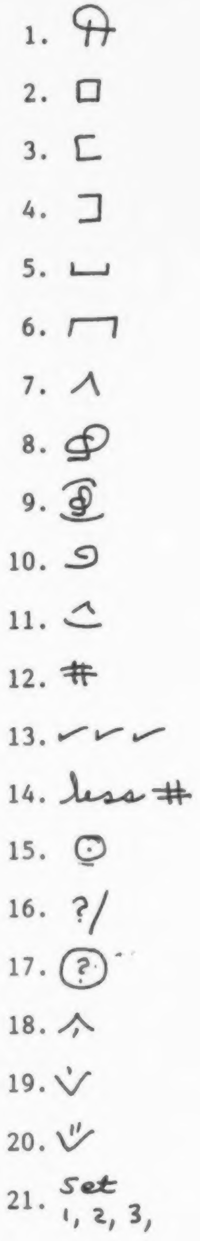
PROOFS PROOFREADING AND CORRECTIONS

Match Proofreaders Marks

Directions: Match the proofreader's marks on the right with the correct meaning.

_____A. Close up
_____B. Insert question mark
_____C. Move to right
_____D. Wrong font
_____E. Query to author
_____F. Paragraph
_____G. Equalize spacing
_____H. Set in lower case
_____I. Insert apostrophe
_____J. Set in captials
_____K. Move to left
_____L. Insert marginal addition
_____M. Insert period
_____N. Set in roman type
_____O. Turn inverted letter
_____P. Indent one em
_____Q. Reduce spacing
_____R. Insert comma
_____S. Lower
_____T. In this order
_____U. Let it stand

MARKS



_____V. Elevate

_____W. Insert quotes

_____X. Set in bold face type

_____Y. Delete and close up

_____Z. Insert space

____AA. Set in italic type

____BB. Delete

____CC. Set in small captials

____DD. Lowercase letter

22. wf
23. bf
24. rom
25. ital
26. Caps
27. sc
28. lc
29. ₰
30. stet

OFFSET LITHOGRAPHY

Vocational

Demonstrate knowledge of basic safety concepts

1. Student will demonstrate knowledge of basic first aid concepts. See module at the end of this guide.

2. Student will demonstrate proper handling of chemicals. Instruct the student in the proper use of chemicals using the do's and dont's list found below. If possible the chemistry teacher would be and ideal person to teach this concept.

   The DO's and DON'Ts for handling chemicals properly

   A. DO pour chemical into water, never water into the chemical

   B. DO wear rubber gloves when handling chemicals

   C. DO wear safety glasses when mixing or pouring chemical

   D. DO return chemicals to proper cabinet after use

   E. DO NOT mix or weigh chemicals in darkroom unless strong ventilation is present

   F. DO NOT mix solutions near eyes or face

   G. DO NOT place any containers on edges of counters

   H. DO NOT use any unmarked containers

SUGGESTIONS FOR PARENTS:

1. Have student put together a first aid kit for home use.

2. Have student demonstrate to family correct handling of chemicals.

3. Have student conduct a mini-emergency situation handling presentation for the family.

Resources

Mid-America Vocational Curriculum Consortium, Inc. 1981.
1500 West Seventh Avenue
Stillwater, Oklahoma 74074
1-800-328-1452

Graphic Arts: Book one: Orientation, Composition, and Paste-up, Karim Tarajollohi, Gary Ogle, William Reed, Kenneth Woodcock

McKnight Publishing Company
Bloomington, IL 61701

Photo-Offset Fundamentals, John E. Cogoli

Vo-Tech Division of the New Mexico State Department of Education, 1975.
Albuquerque, NM 87503

Graphic Arts - A Curriculum Manual, Bruce Hawkinson

Delmar Publishing
Albany, NY

Printing Layout and Design, Kenneth Orr

Art Direction Book Company, 1974.
NY 10036

Advertising Production: Planning and Copy Preparation for Offset Printing, H.C. Latimer

INSTRUCTIONAL MODULE

ACCESS SKILL: APPLY BASIC MEASUREMENT CONCEPTS

TASK ANALYSIS STEPS: A-G

VOCATIONAL AREAS:
Carpentry

ACTIVITY	MATERIALS/RESOURCES
TASK A: Student will become familiar with the meaning of the word "measure".	
1. Introduce the unit to the students by asking one to define the word "measure". Explain to the students that the term "measure" means the act or process of finding the size, weight, height, temperature, or length on an object. Ask the students to think of things they measure and why. Some may come up with their weight, their height, their shirt size, etc. Others might be thinking of the area of a room to be carpeted or the depth of a hole for planting a seed, etc. Still others may suggest measuring in order to locate the spot to sew on a button or where to put a hem in a dress.	
2. Write the word MEASURE on the board and ask the students to break into groups. Ask the groups to decide how many words can be made from the word measure. (Such as: me, as, sure, muse, smear, etc.) Require the students to learn to spell the word measure and to write it in a sentence. Allow them to discuss freely what they have measured and why.	Chalkboard, chalk
TASK B: Student will identify tools of measurement.	
1. Brainstorm with the students to recall any tools of measurement they have used. Write each tool on the board and talk briefly about each as you write it--discussing its uses. Be sure to include the following in your discussion: ruler, yardstick, scales, thermometer, tape measure, gauges, etc.	Chalkboard, chalk
2. Show the students pictures of each of the tools and ask them to match each tool with its proper name (Worksheet B2).	Worksheet B2 Pictures of tools of measurement
3. Add pictures of other tools and determine if the students can select which are tools for measurement.	Pictures of tools of measurement and other tools
4. After discussing various tools used for measurement with students, ask why they think we bother to measure things and how it got started. Show the filmstrip "The History of Measurement and Length" if it is available in your school's math resource materials.	"The History of Measurement and Length"
TASK C: Student will identify appropriate tools used to measure various objects.	
1. Discuss with the students why we use specific tools to measure various objects and introduce the topic by showing the students tools (yardstick, ruler, tape measure, bathroom scales, etc.) and asking them if they have ever used these tools.	Tape measure, ruler, yardstick, thermometer, scale
2. Give each student or pair of students a tool of measurement Allow them ten minutes to think about how the tool might be used. Ask the students to list the number of items they can think of that might be measured with that tool. Count only the accurate items to be measured and award a prize for the pair or person who came up with the most items.	Tape measure, ruler, yardstick, scale, thermometer, paper, pencil

ACTIVITY	MATERIALS/RESOURCES
TASK C: CONTINUED	
3. Give each student a list of items which could be measured with one or more of the tools and have the students list under the item which tools would be used best or most often	Worksheet C3
TASK D: Student will use tools of measurement appropriately.	
1. To reteach, enrich or provide extra practice use worksheets similar to Worksheets D1a-D1j in reading and measuring with rulers. This could be adapted by using the pictures of measurement tools on Worksheet B2 and using the same or similar information to reteach or enrich the skills the students have learned at each learning station.	Worksheets D1a-D1j Worksheet B2
2. List each student's name on a sheet of paper. Have each student write his/her height on the paper. Then ask various students to measure another student to see if they actually knew their measurement.	List of students Rulers, yardsticks
3. Give each student (if possible) an object such as a quart jar, a pint jar, a cup, or a gallon jug. Have the students measure to see how many cups make a pint, a quart, and a gallon. Then have the students measure various objects with these containers (such as flour, sugar, water, juice, jello, etc.). Have the students complete their own charts as to how many of one measure it takes to fill the other larger container such as in Worksheet D6.	Liquid measures Worksheet D3
TASK E: Student will accurately associate measurement name with symbol and vice versa.	
1. Point out to students that many times instead of writing out a word for a unit of measurement, we often use symbols or abbreviations (like abbreviating the months of the year, etc.) and that it is important to know both the symbol and the word for which it stands. Write a few examples on the board and see how may students actually know the symbols for the words. For example: Write pt. amd ask if anyone knows what that stands for. If no one answers, write the word "pint" out to the side and leave it on the board. Tell the students that is the symbol for the word pint. Use examples for words such as inch, foot, yard, quart, pint, mile, gallon, ounce, pound, degrees Farenheit. Then provide the students with a worksheet in which they can match the symbol with the word as on Worksheets E1a and E1b.	Worksheets E1a, E1b
TASK F: Student will accurately compute equivalent units of measure.	
1. Show the students lines of varying lengths (inch, foot, yard) and ask them to label each correctly. Check to make sure each student can accurately identify the correct unit for each.	Chalkboard, chalk
2. Ask the students if they know the number of feet in one yard. If they know, ask them to demonstrate to you. If they do not know, demonstrate to them that three feet (or three rulers) make up one yard.	Ruler, yardstick

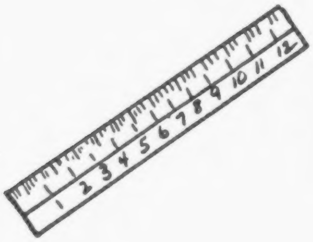
ACTIVITY	MATERIALS/RESOURCES
TASK F: CONTINUED	
3. Ask the students to identify the number of inches in a foot and a yard. If the students cannot accurately identify the number of inches, once again, using a ruler and a yardstick, demonstrate to the students the number of inches in that unit of measurement. Have the students then make a chart of the number of feet in a yard (from F2 above) and the number of inches in a foot.	Yardstick, ruler
4. Ask the students to figure the accurate number of feet when given various measurements such as: How many feet are in 7 yards 8 inches? (21 3/4 feet.) Give the student enough problems of this type until you are sure he/she can accurately find the measurement without assistance.	
5. Give the students a list of measurements in yards and ask them to convert each into inches and feet. For example: 3 yards = 9 feet = 108 inches.	
6. Give the students a list of inches and ask them to convert each into the accurate number of feet and yards. For example: 72 inches = 6 feet = 2 yards.	
TASK G: Student will accurately determine the ratio of cups, pints, quarts, and gallons as well as pounds and ounces.	
1. Introduce this lesson to the students by showing various tools needed for this type of measurement (cup, pint, quart, gallon, ounce and pound weights and a scale). Have the students verbally identify each of the tools of measurement.	Cup, pint jar, quart, gallon, ounce and pound weights, and a scale
2. Fill a cup with water and ask how much water is in the container. Then ask the students to fill the cup to various levels (1/2, 1/4, 3/4, 1/8, 1/3, etc.). Use water and then use dry ingredients also to make sure they understand that the item in the cup must be level in order to be measuring accurately.	Cups, water, flour, or some other dry ingredients
3. Give the students the measuring cups with varying amounts of contents and have them accurately measure each and place in order of smallest to largest.	Measuring cups with ingredients
4. On the chalkboard or overhead, demonstrate to the students how they can convert pints to quarts, etc. For example: Ask the students how many quarts would be in 6 gallons, how many quarts in 10 gallons, how many pints in 4 gallons, etc.	Chalkboard and chalk or overhead projector

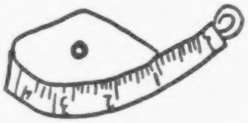
Worksheet B2

Identification of Tools

Match the correct name with the correct tool for measurement.

Thermometer
Scale
Cup
Ruler
Tape Measure
Balance
Gauge


1 2 3 4 5 6 7 8 9 10 11 12



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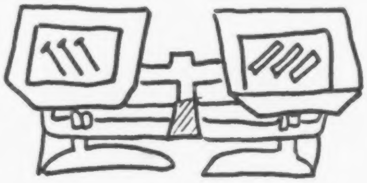

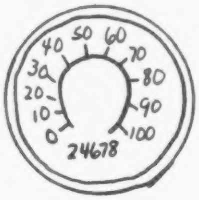
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80
90
100
24678

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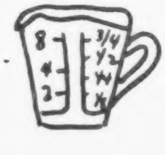
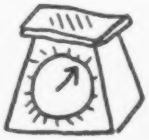

8
4
2
3/4
1/2
1/4
1/8



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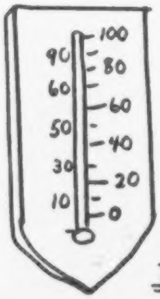

100
90
80
60
60
50
40
30
20
10
0

____

Worksheet C3

Direction: I have listed below several items which could be measured with one or more of the tools we have studied. Under each item, write the tool or tools which could be best used to measure that item.

1. Temperature of a room

   ____

   ____

2. Oven temperature

   ____

   ____

3. The mass of a cup of coffee

   ____

   ____

4. The length of a nail

   ____

   ____

5. The diameter of a circle

   ____

   ____

6. The height of a door

   ____

   ____

7. The perimeter of a basketball court

   ____

   ____

8. The distance between bases on a baseball diamond

   ____

   ____

9. Someone's waist measurement

   ____

   ____

10. Amount of water in a thermos

    ____

    ____

Worksheet D1a

Reading and Measuring With Rulers

After you study this lesson, you should be able to:

1. Identify tools and materials used in reading and measuring with rulers.
2. Read the ruler in whole numbers
3. Read fractions of an inch on a given ruler.
4. Measure objects with a ruler.
5. Draw lines and objects to length using a ruler.

Show What You Can Do.

Check the statement that fits you best.

1. ☐ **I can do all the tasks above and want my instructor to give me the Practical Exercise.**

SEE YOUR INSTRUCTOR

2. ☐ **I want to study the information in this unit before I do the Practical Exercise.**

TURN THE PAGE AND BEGIN

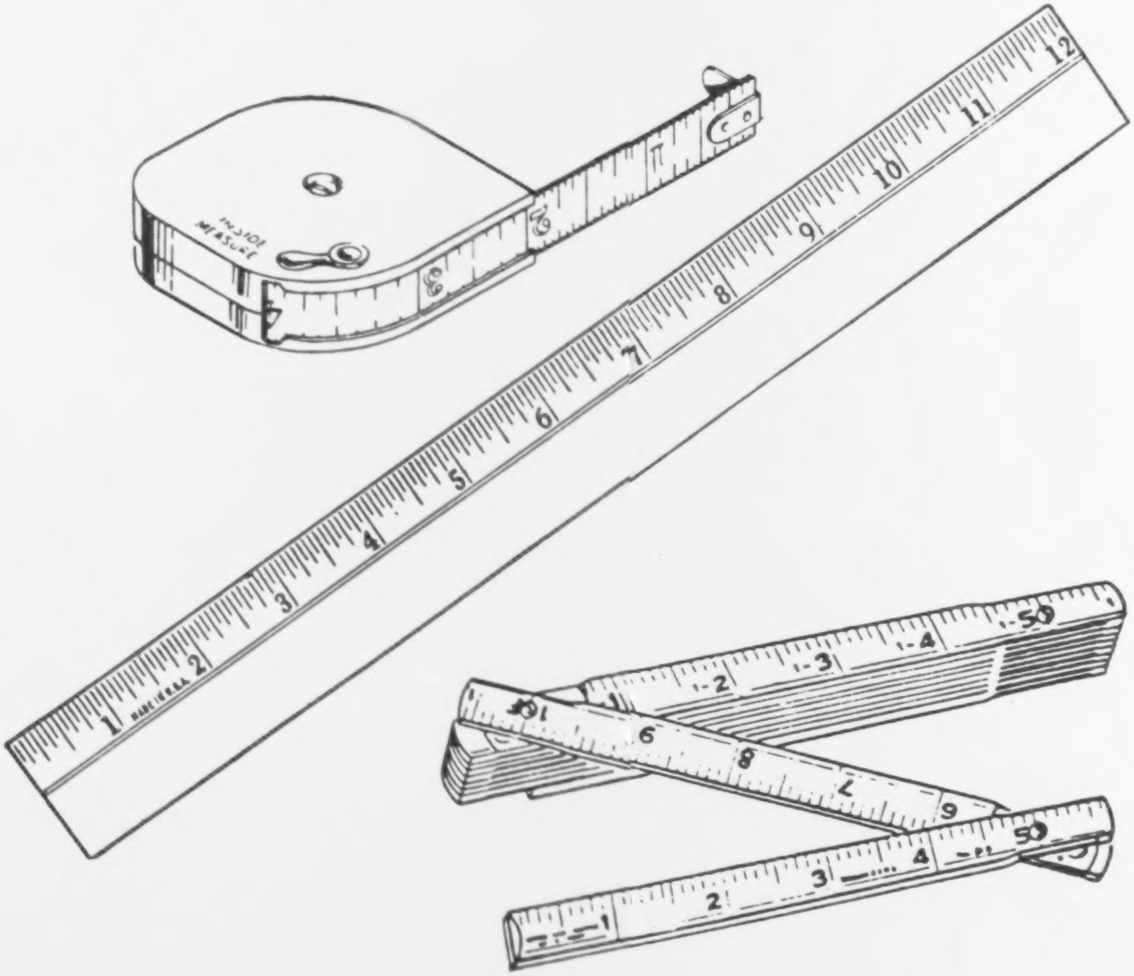
Worksheets D2a-j are reprinted from Instructional Material Laboratory publication SN-10-S, University of Missouri-Columbia.

Worksheet D1b

Reading and Measuring With Rulers

Introduction

The ruler is the most important of all hand tools. Without the use of the ruler it would be difficult to build anything accurately.

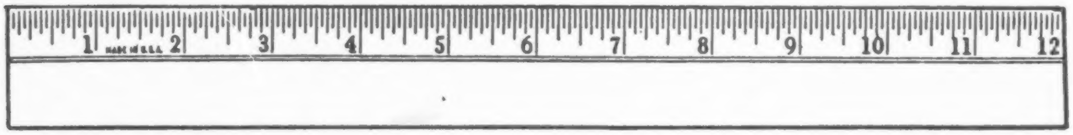

INSIDE MEASURE
1
2
3
4
5
6
7
8
9
10
11
12

In this unit you will study how to use diifferent types of rulers and how to read them.

Worksheet D1c

A. Tools, Materials and Equipment for Reading and Measuring With Rulers.

1. **12" RULER (GRADUATIONS IN 1/16"):** Used to measure materials and complete assignments.


1
2
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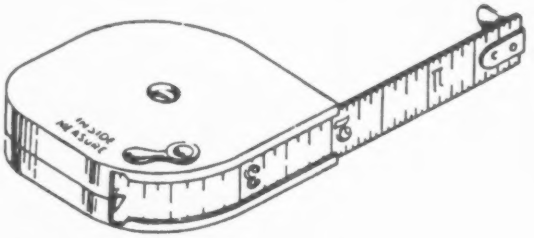
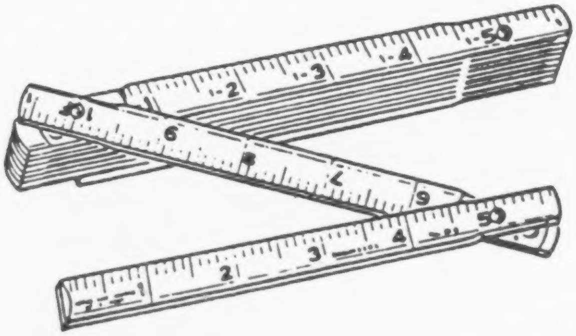
7
8
9
10
11
12

2. **PENCIL AND PAPER:**

3. **TAPE RULE:** Used to measure objects and lumber.

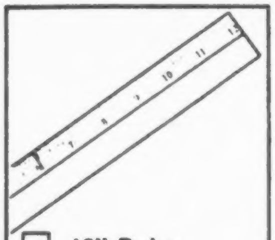

INSIDE MEASURE

4. **FOLDING RULE:** Used to measure objects and lumber.

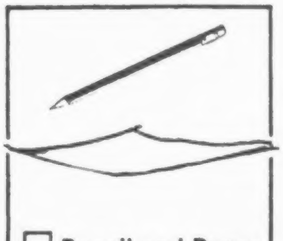


Worksheet D1d

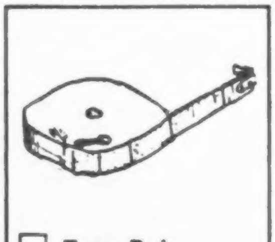
1. Find and Check Off the following:



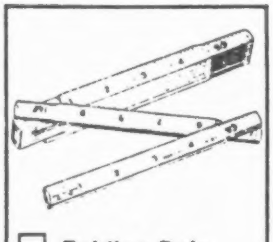
☐ 12" Ruler



☐ Pencil and Paper

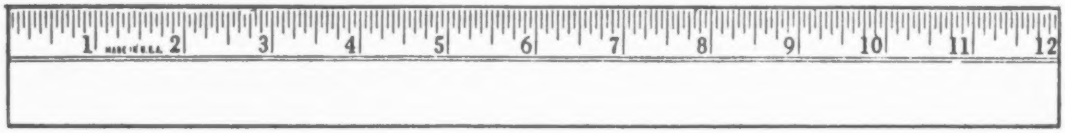


☐ Tape Rule



☐ Folding Rule

2. Secure a 12" ruler from your instructor.


1
MADE IN U.S.A.
2
3
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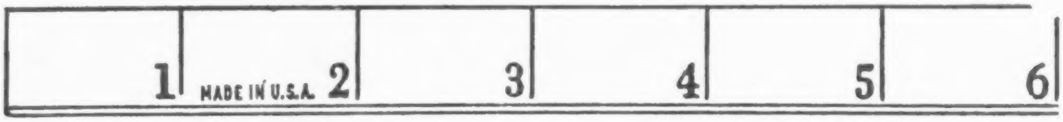
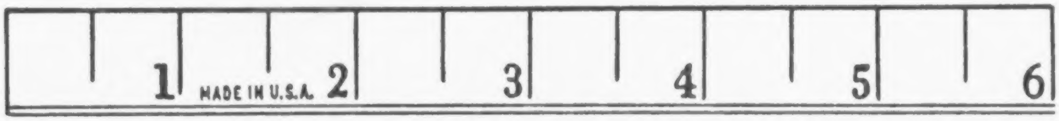
11
12

3. Using the following illustration, study the divisions of the ruler and practice reading whole units.


1
MADE IN U.S.A.
2
3
4
5
6

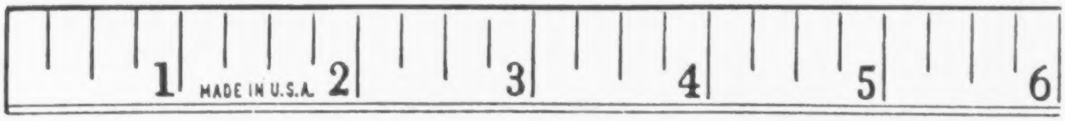
Each unit is one inch.

4. Using the following illustration, study the divisions of the ruler and practice reading half units.


1
MADE IN U.S.A.
2
3
4
5
6

Each unit is one-half inch.

5. Using the following illustration, study the divisions of the ruler and practice reading quarter units.


1
MADE IN U.S.A.
2
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4
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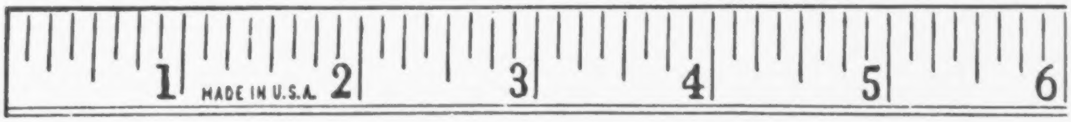
6

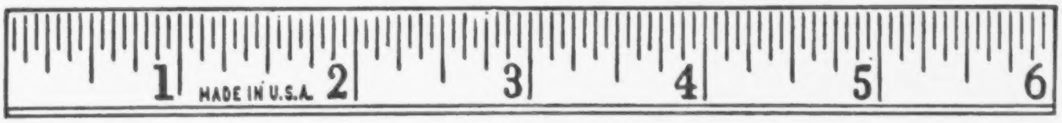
Each unit is one-quarter inch.

6. Using the following illustration, study the divisions of the ruler and practice reading eighth units.


1
MADE IN U.S.A.
2
3
4
5
6

Each unit is one-eighth inch.

7. Using the following illustration, study the divisions of the ruler and practice reading sixteenth units.

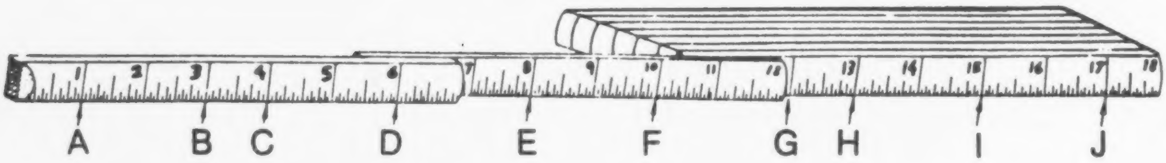

1
MADE IN U.S.A.
2
3
4
5
6

Each unit is one-sixteenth inch.

Worksheet D1f

C. Reading Whole Numbers on the Folding Ruler.

1. Using the following illustration determine the distance in inches for the given letters in the drawing.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12
13
14
15
16
17
18
A
B
C
D
E
F
G
H
I
J

A =____

B =____

C =____

D =____

E =____

F =____

G =____

H =____

I =____

J =____

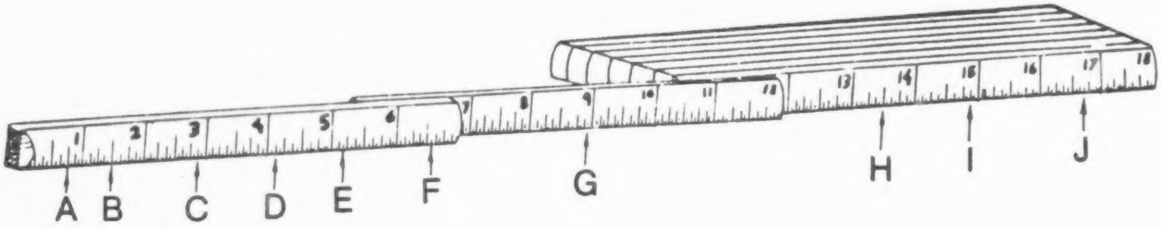
Worksheet D1g

D. Reading Fractions on the Folding Ruler

1. Using the following illustrations determine the distance in fractions for the given letters in the drawing.

NOTE!

12" is equal to one foot.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12
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14
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16
17
18
A
B
C
D
E
F
G
H
I
J

A =____

B =____

C =____

D =____

E =____

F =____

G =____

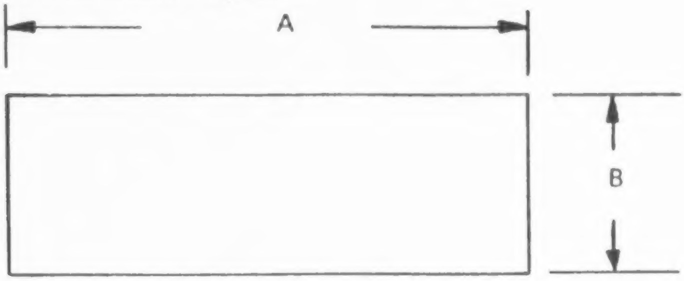
H =____

I =____

J =____

E. Measuring Objects Using a Rule With 1/16" Graduations. Measure the correct lengths and heights below and write your answer in the blank space.

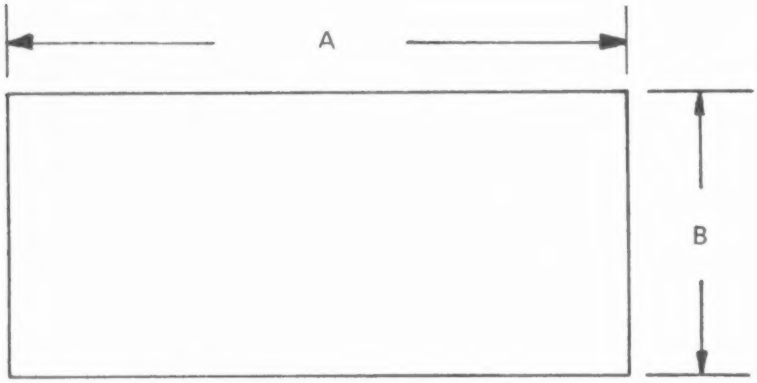
1\.



A. Length________________

B. Height________________

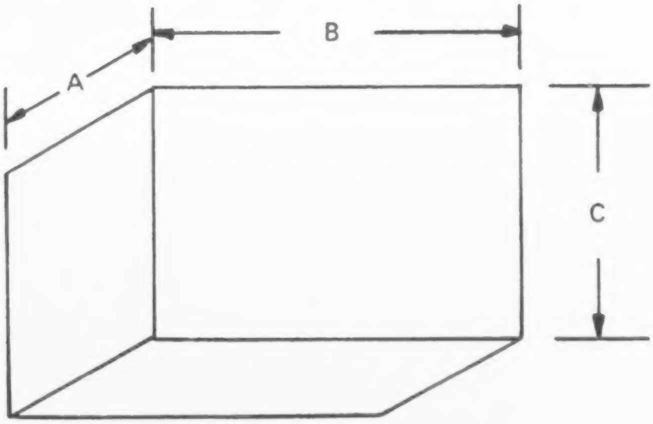
2\.



A. Length________________

B. Height________________

3\.



A. Width________________

B. Length________________

C. Height________________

Worksheet D1i

F. Drawing Lines With a Ruler.

1. Using a rule with 1/16" graduations, mark the correct line length on the lines below.

a. 3 3/4 inches

b. 2 1/16 inches

c. 1 1/4 inches

d. 3 10/16 inches

e. 2 1/2 inches

f. 2 5/8 inches

Worksheet D1j

Unit 4
Reading and Measuring With Rulers

Tools and Materials Identification Exercise

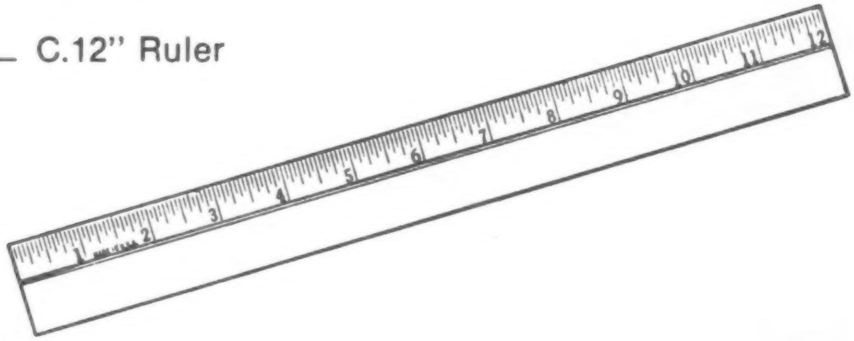
Student's Name:____

Match each object with its correct name.

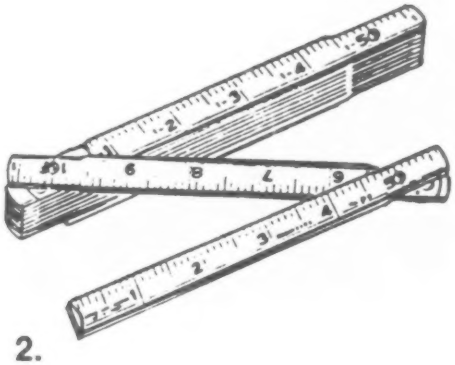
____ A.Folding Rule

____ B.Tape Rule

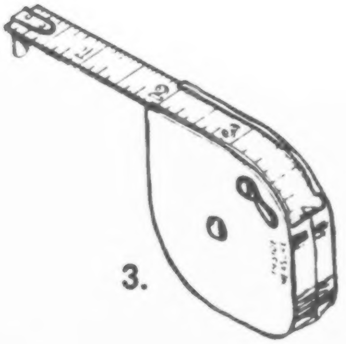
____ C.12" Ruler



1.

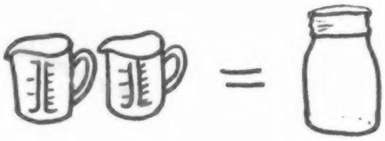


2.

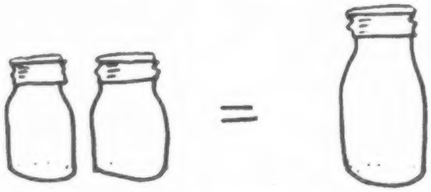


3.

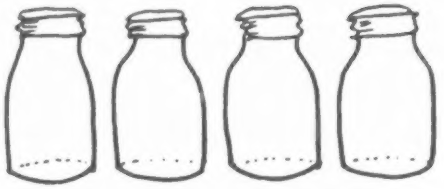
Worksheet D3



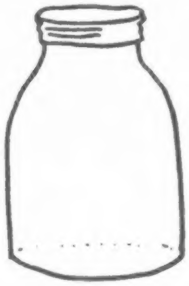
2 cups equals 1 pint



2 pints equals 1 quart



4 quarts equals 1 gallon



1. 4 qt. = ________ gallon
2. 4 pt. = ________ qt.
3. 4 cup = ________ qt.
4. 1 qt. = ________ cup
5. 3 qt. = ________ pt.
6. 8 pt. = ________ gallon
7. 1 gallon = ________ pt.
8. 16 cups = ________ gallon
9. 8 qt. = ________ gallon
10. 1/2 pt. = ________ cup

Worksheet Ela

Match the following abbreviations or symbols with the words that mean the same.

inch
mile
gallon
ounce
quart
pound
pint
yard
foot
degrees Farenheit

ft.
F
pt.
m
oz.
in.
yd.
lb.
qt.
gal.

Worksheet Elb

Directions: Write beside the words, the symbol for each:

foot ______________________________

inch ______________________________

yard ______________________________

mile ______________________________

quart ______________________________

pint ______________________________

pound ______________________________

degrees Farenheit ________________

INSTRUCTIONAL MODULE

VOCATIONAL AREAS:
All Trade and
Technical Areas

ACCESS SKILL: DEMONSTRATE SAFETY PROCEDURES FOR VARIOUS ACTIVITIES

TASK ANALYSIS STEPS: A-J

ACTIVITY	MATERIALS/RESOURCES
TASK A: Student will identify and define "safety" and "emergency".	
1. The teacher directs the lesson on safety by asking if the students understands "safety." If taught in a group, the students could break into small groups to define safety and give an example of it. Explain to the students that they are responsible for their own safety and that is why they are to learn about it in this lesson.	
2. Ask some "What if" questions. For example: What if you were told to climb a ladder and you didn't know how to set it up, what would you do? What if you were to cut up a salad where you work and you had never worked with a knife before, what would you do? These are things the students will learn in this lesson.	
3. Define "safety" as the state of being safe. Explain it to the students further by saying that it is when you are not in danger, you are safe. Write "safety" on the board.	Chalk, chalkboard
4. Define "emergency" as a sudden important happening or accident. Ask the students if they know what emergency means and ask them to give an example of an emergency. Make sure each student understands both definitions before moving on. Write "emergency" on the board.	Chalk, chalkboard
5. Individually ask each student to identify "safety" and "emergency."	
6. You might also want to add to the students definition the word "accident" and define it. Explain to the students that more than half of the accidents occur in the home--a place we would consider safest.	
TASK B: Student will discuss safety procedures of which he/she is presently aware.	
1. Explain to the students that the purpose of this lesson is to see how many safety procedures he/she is currently aware of.	
2. Ask students to write about, tell about, or role play with another student a safety procedure he/she is aware of. For example: When climbing do not stand on a chair, but use a ladder. Do not keep matches over a stove. Do not put your hand or other objects on a hot stove or in hot water, etc.	
3. Once students have exhausted their knowledge of safety procedures, identify other areas such as proper ways to lift, bend, push, pull, cut with a knife, use power tools, use hand tools, properly erect a step ladder and climb, read and understand safety instructions.	
4. Invite guest speakers to demonstrate the proper methods of performing the above skills safely. Have the students report on each one if they are already aware of the safety precautions necessary.	Guest speakers Worksheet B4

ACTIVITY	MATERIALS/RESOURCES
TASK C: Student will identify various situations in which it is necessary to know the proper safety techniques.	
1. Introduce lesson by discussing with the students that it is important to know the proper safety techniques to use in various situations. Ask the students if they can identify some of these situations. (This might be a review for some students, but some may come up with some new ideas.)	
2. Invite a guest speaker from the Fire Department, Health Department, First Aid or Red Cross Agency, or a safety administrator in a local business to speak to the group on safety precautions that are taken on the job and those the students must take on their own.	Guest speaker
3. Give the students newspapers and magazines and ask them to identify various situations in which an accident could have been prevented if someone would have used the proper safety precautions. Have them cut out pictures or articles about an accident and tell the proper safety procedures which should have been used.	Newspapers, magazines
4. Discuss with students safety procedures we see each day, such as stop signs, traffic lights, one-way signs, etc. Sometimes in cafeterias we see signs which tell us that a microwave oven is in use. What difference does that make? Elicit from the students the purpose behind some of these common warnings that they might take for granted.	Pictures of signs
5. Assign the students a person to watch and report about. Tell the students to watch the person for at least ten minutes and see how many situations he/she used proper safety procedures in and how many he did not. They should also tell what the person was doing and how to remedy the situation if it needed to be remedied. For example, one student might be assigned to watch the school janitor after school to see what he/she does and then write a report on what he/she saw.	
6. In talking about safety in various situations you might discuss job safety. What kinds of jobs are most dangerous and why? Students could be assigned a small research project regarding the amount of danger involved in the occupations in which they are interested. They could then discuss, write, or role play ways in which they could be safe should they decide to take that job. Don't forget to discuss small things like wearing gloves when cleaning ovens, walls etc., especially if they are working in a job which does a lot of cleaning.	
TASK D: Given various situations the student will become familiar with the safety procedures involved.	
1. Introduce the lesson by telling the students that they will become familiar with various safety procedures and actually demonstrate them during this portion of the lesson.	
2. Begin with showing the students proper and improper techniques for lifting and moving objects. Explain that there are proper and improper ways to lift objects. After demonstrating the proper methods have each student do so. (Sometimes feeling the difference is necessary, therefore the demonstration of movement in each is necessary.) See examples on Worksheets D2 and D2a.	Worksheets D2, D2a

ACTIVITY	MATERIALS/RESOURCES
TASK E: Given basic first aid training the student will become familiar with some of the safety procedures involved.	
1. Introduce to the students the following lesson by asking how many of them know anything about first aid. Any of the students who know first aid might want to act as an aide after having had their procedures checked out by the teacher for accuracy.	
2. Borrow books on first aid from the American Red Cross Agency. Give each student a copy of the book and cover the most important parts. For example: Poison - What to do if someone swallows a bottle of aspirin or eats a poisonous substance and doesn't know it, etc. (Check with the poison control center in your location for more information.) You might also cover auto accidents, broken bones, burns, falls, fevers, seizures, lacerations, bites, etc.	Basic First Aid from the American Red Cross Agency, Boy Scouts of America Handbook and Merit booklet on first aid
3. The American Red Cross has several films which emphasize particular portions of the Basic First Aid book. These are especially helpful for the student who learns visually and can associate.	
4. Give the students various situations and ask what they would do in that instance to determine if they have accurately picked up the necessary first aid skills. For example: If a person has fallen down over the side of a hill you should? a. tell him to get up and walk. b. tell him to stay calm and not to move. c. move all of his limbs to see if they are broken. Answer: b	
5. Teach the students to get help as soon as possible and to not leave the injured person unless absolutely necessary.	
6. Review with the students how to reach an ambulance (call 911).	
7. Teach students how to deal with wounds and lacerations: a. stop the bleeding b. protect the wound from getting dirty or infected c. keep the person warm and lying down d. get help	Use the American Red Cross First Aid book for details
8. Ask the students what they think they should do if they get something in their eye. Demonstrate how to treat an eye injury. a. keep the person from rubbing his eye b. wash your hands and check his eye by pulling the eyelid away if necessary c. don't try to get something out of the eye with any other object d. get him to a doctor as soon as possible e. if it is a chemical burn you will need to follow the safety instructions on the container which usually say to wash the eye. In this instance you run a gentle stream of water over the eyeball with the eye open for a specified period of time (usually 10-15 minutes).	
9. Invite a guest speaker from the American Red Cross Agency to demonstrate how to make bandages and dressings for identified injuries (broken bones, cuts, etc.).	Guest speaker

ACTIVITY	MATERIALS/RESOURCES
TASK E: CONTINUED	
10. Visit a hospital emergency room and ask the emergency medical technicians to demonstrate moving an injured person by pulling the person, one-man lift, two-man lift, and six-man carry. They might also demonstrate fore-and-aft carry and how to carry someone using a blanket.	Field trip to an emergency room
11. Discuss burns and the varying types (sun, chemical, water, electrical, etc.). Review the signs and symptoms for burns and what to do for them. (Keep the patient covered, comfortable, and moistened.)	
12. Using the American Red Cross First Aid book review the procedures for giving CPR. If it is felt that this is necessary for your students ask one of the CPR instructors from the American Red Cross to do the training. CPR is a special procedure and requires specific training in order to teach it.	CPR instructor
13. Assign the student(s) the task of calling Tel-Med in order to find out more about other first aid training. Require them to report to the class what they have learned. Be sure to check the students after each segment of the first aid training.	
*Note: Because first aid training could take a full year to teach, select the areas of training which best fit the needs of your student(s) and teach practical skills - symptoms and treatments.	
TASK F: Student will distinguish between types of knives and the safety procedures for using knives.	
1. Discuss with the students the objective of this lesson - varieties of knives and how to use them safely.	
2. Remind students that knives are not acceptable at school and ask if they know why. (Because they are dangerous.)	
3. Ask students to identify various knives they are familiar with (pocket, kitchen, steak, dinner, slicing, paring, etc.). Ask the students if they are familiar with these and if they have ever used any of them. One at a time introduce the knives to the students and demonstrate the proper use of each. Remind students to always cut away from themselves so that if the knife should slip they would not be cut. (If you do not have access to each of these types of knives use the pictures on Worksheet F3 to show students examples.)	Worksheet F3
4. Show students not only how to use the knives, but also how to safely carry knives--carrying it by the handle with the blade down and the sharp edge facing behind them. Tell them to carry it out to the side, but not so far that they would hurt someone who might walk beside them. Have the students demonstrate this using a wooden or plastic knife until safe procedures are completely learned.	Knives
5. Using a paring knife demonstrate the proper way to cut food --on a cutting board, pressing down on the knife blade with one hand and firmly holding the handle with the other, remembering to keep all fingers and other body parts out of the way. Allow each student a chance to demonstrate the	Paring knife, cutting board, vegetables

ACTIVITY	MATERIALS/RESOURCES
TASK F: CONTINUED	
safe procedure. Discuss with the students why we use a cutting board vs. our hand or the counter top. Remind students that a cutting board gives us a good solid surface, protects counters, and usually keeps objects from slipping as they might on a counter. We should never hold an object in our hand to cut, because we might cut our hand.	
6. Demonstrate the safe way to open a pocket knife by laying it on its side on a flat surface and holding it down firmly with one hand. Gently open the blade to the first notch. Once it is opened that far you may turn it up or leave it as it is and open it the rest of the way. Remind students to always close the knife as soon as they are finished using it. Show them the proper way to close the knife. Once again place the knife on its side on a flat surface and firmly hold in place with one hand while closing the knife with the other hand.	Pocket knife
TASK G: Student will demonstrate the safety procedures for using power tools.	
1. Introduce the lesson by pointing out to the students that safety is always their responsibility and accidents are always painful to the victim and to others around him/her.	
2. Ask the students to name a few power tools they are familiar with (drill, electric saw, etc.). Ask them to tell the safety procedures they are familiar with in using these tools.	
3. Invite the shop teacher in to talk to the students about shop safety--especially regarding power tools. If the shop teacher cannot make a guest appearance, perhaps a senior student who is very competent and is checked out by the shop teacher would like to demonstrate the safety procedures.	Guest speaker and shop tools
4. Use the rules on Worksheet G4 to reinforce the need for safety procedures when using power tools.	Worksheet G4
5. Ask the students to each think of another rule about using power tools and list them on the board. Then combine all of the lists together on one sheet. Assign the students to take the list home and ask their parents for other safety precautions that were possibly forgotten in the class.	Chalk, chalkboard
6. Show the movie "Safety in the Shop: Basic Practices" which demonstrates safety in using both power and hand tools in both wood and metal shops. Ask students to discuss the rules they learned from the movie which they had overlooked in previous assignments. Add this list to the list made in Activity 5 and assign a group of students to make a special bulletin board with all of the rules displayed.	"Safety in the Shop: Basic Practices"
TASK H: Student will recognize and identify hot surfaces and demonstrate ways to keep oneself and others safe from hot water and hot surfaces.	
1. Introduce the lesson to the students by asking them to name some "hot" things they are familiar with which might burn them. Ask them to think of as many as possible. (They	

ACTIVITY	MATERIALS/RESOURCES
TASK H: CONTINUED	
might name stoves, ovens, furnaces, hot water pipes, fireplaces, cigarettes, metal exposed to sunshine, motorcycle and other exhaust pipes, etc.)	
2. Discuss burns with the students and ask them to label some common causes of burns (carelessness with cigarettes or matches, scalds from hot liquids, use of strong chemicals, defective heating, cooking, electrical equipment, use of open fires, getting into overly hot bath water, etc.). Tell them that a burn is an injury which results from heat, chemical agents, or radiation (like from the sun), and it can cause serious illness, injury, or possible death.	
3. Bring into the classroom some of the above mentioned causes of burns (those which are safe to show), or show pictures of some of these burn causing agents. Ask the students to determine the reason these things might cause burns and how the burns can be prevented. For example, show the students a drawing of someone getting into a tub of steamy hot bath water and getting burned. Ask the students how that could be prevented. They might need to get into small groups to be sure they do not leave out any possible prevention methods. For examples see Worksheet H3.	Materials which show possible burn agents, pictures of burn causing agents or hot surfaces and/or Worksheet H3
4. Show the film "Kitchen Safety: Preventing Fires" and discuss grease fires and cleaning stove hoods and duct systems to keep them safe. Also discuss fires in deep fat fryers, grills, trash cans, and electrical equipment.	"Kitchen Safety: Preventing Fires" "Fire Prevention: In the Home" Both are available from the Academic Support Center at UMC
5. Discuss with the students that sometimes a burner doesn't look hot, but it is. We must know ways of checking hot surfaces without burning ourselves. Ask how many students are familiar with "hot wires." Explain to the students that these wires may not be hot to the touch, but could electrocute or burn a person if handled in the wrong way. We must therefore learn to handle the wires safely. Follow up with the movie "Fire Prevention: In the Home" which discusses fires in electrical outlets, and other danger spots such as the attic and basement.	
6. Cut several strips of paper and write various fire hazards on the paper. Ask each student to pantomime what they would do if they were injured in that way. Then ask another student to role play or tell ways that type of injury might be prevented. For example, a student might pull a slip of paper with the words "cigarette burn" written on it. The student would act out getting a cigarette burn--maybe by sitting in a chair and falling asleep with a make-believe cigarette in his/her hand. The other student would act out the part of prevention by simply putting out the cigarette before closing his/her eyes while sitting in the chair.	Strips of paper with fire hazards written on them
7. Invite someone from the Fire Department or a local restaurant to talk about fire safety and keeping oneself safe from burns or hot surfaces that could potentially burn.	Guest speaker
8. Ask students to list as many incidents as they can possibly think of in which someone might get burned. Have the students take the paper home and check with their parents to see if their home is safe from these burn possibilities.	

ACTIVITY	MATERIALS/RESOURCES
TASK I: Student will demonstrate the correct method for setting up and climbing a ladder.	
1. Introduce the lesson by showing the students a ladder or a picture of a ladder. Ask the students what a ladder is used for. Be sure everyone can identify a ladder and its use before going on. (Show straight and folding ladders.)	Ladder or picture of ladders
2. Explain to the students that a ladder is used for climbing. Ask why we can't just use chairs (some are too high, they are not safe or sturdy enough sometimes, etc.). Discuss possible hazards of using a chair for climbing. Discuss possible hazards of using a ladder. Point out to the students that the ladder must be in good repair.	
3. Invite a painter in to demonstrate how to prop a ladder against a building in order to paint. Point out that a straight ladder should be placed at a 70 degree angle with the ground. Ask why that is so important. (Students should respond with something to the effect that if the ladder is too far away, it can easily slip; if it is too close, the least change in the distribution on your weight at the top can cause it to topple backwards.) Do not demonstrate climbing and having this happen, but do allow each student to set the ladder up at a 70 degree angle to make sure they understand approximately what 70 degrees looks and feels like.	Guest speaker Straight ladder
4. Discuss with the students that when using a straight ladder you must make sure the ladder is the right length. If it is too short it could easily slip. It should generally be at least 3 feet above the roof to give you an extension to lean against so you don't fall. Show students pictures of ladders beside houses and have them select the ladder best suited for the job. Make sure they understand the ladder should be taller than the job needed.	Straight ladder
5. Ask the students what they would do if they set up the right length ladder at the right distance from the building, but they could not reach the whole side of the building from the ladder in order to paint the building. (Students will hopefully respond that they would have to get down from the ladder frequently in order to move it and not try to move the ladder by standing on it or not try to paint leaning way over.) Make sure the students understand the danger of stretching far to do a job while standing on a ladder.	
6. Bring in a step ladder and ask each student to set it up in the proper fashion (after a demonstration). Be sure to get a sturdy ladder and check the following: Is it in good repair? Does it have rubber tips to keep it from sliding on a slick floor? Do the hooks on the ladder work safely? Are there any cracks in any part of the ladder? Then, open the ladder, spread both sides evenly apart, hook each side snugly into place, and test the strength of the ladder by putting your weight on it (lifting your feet just off the floor). Then have the students climb the ladder with assistance if necessary. Finally have them climb down from the ladder (again, with assistance if necessary, but eventually alone). You might want to put each of these steps on a sheet and check off only the parts the student can do alone.	Folding step ladder Checksheet of ladder safety

ACTIVITY	MATERIALS/RESOURCES
TASK J: Student will read and understand basic safety instructions.	
1. Explain to the students that being able to read and understand safety instructions is important whether they are working in a shop, McDonald's, their own kitchen, or wiring a toy for a child for Christmas. Ask the students to think of places where they have had to read safety instructions and if they understood them. Usually instructions are given in a step-by-step format. If they are not, the student would want to break it down that way.	
2. Ask the students what they would do if they were to fix an electrical outlet and the first safety instruction on the directions was "never work on an electrical path or circuit until you have located and disconnected the master switch." Students may have trouble with some of the terms and may need pictures or actual experience going through the safety instructions, so show them the action on Worksheet J2 as a demonstration of following up that job. Give the students worksheets with safety instructions written on one side and pictures of those tasks on the other side. Have them match the picture with the proper safety instruction as on Worksheet J2.	Worksheet J2
3. Locate the safety instructions for various appliances in the classroom (tape recorder, language master, etc.) and ask the students to demonstrate the first safety instruction.	Safety instructions for applicances, etc.
4. Ask the students to report on their at-home activities telling something they learned that they hadn't known previously. Have the other students note all of the safety instructions of which they are now aware.	
5. Name a job to be done which would require safe action. Ask the students to write the safety instructions in a step-by-step process in order to show that they know how to safely use that object.	

Worksheet B4

Name ______________________________

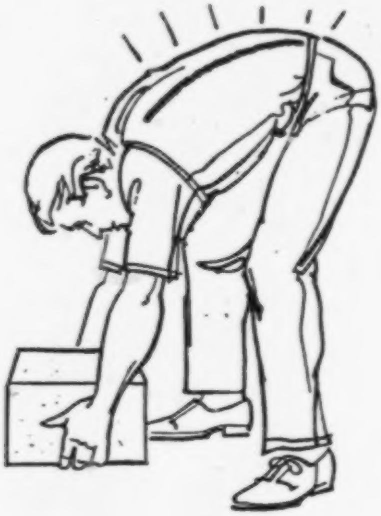
We practice the following safety procedures in my home:

_____ 1. Poisons are put out of the way of small children.
_____ 2. Cords are in good condition with no wires showing.
_____ 3. A smoke alarm is present and works.
_____ 4. My family has a practiced procedure for getting to safety in case of a fire or tornado.
_____ 5. Knives are kept in a safe place.
_____ 6. No toys, books, or other items are placed on the steps.
_____ 7. All of the hand tools in our house are used only by those who have shown they know how to use them safely.
_____ 8. Paper and old oily rags are kept out of areas where a potential fire might result.
_____ 9. Emergency phone numbers are kept by the phone at all times.
_____ 10. Whenever something breaks in my house, we fix it immediately so no one gets hurt.
_____ 11. We have a fire extinguisher that is in working condition and I know how to use it.
_____ 12. The household heating and air conditioning system is checked regularly for safety.
_____ 13. There are not curtains near our fireplace or stove.
_____ 14. We do not plug more than one thing in each electrical outlet.
_____ 15. No one smokes in bed or sets the ashtry on the couch or other flammable objects.
_____ 16. We have occasional home safety discussions.
_____ 17. We do not have wrinkles in our carpet which would possibly make someone fall.
_____ 18. We use a stepladder to reach high places.
_____ 19. We have good lighting in our house - especially on the stairs.
_____ 20. Whenever we spill something, we wipe it up before anyone has a chance to fall.
_____ 21. We keep rubber strips or adhesive strips in the bathtub.
_____ 22. We do not keep electrical appliances (like a TV or radio) on the edge of the bathtub.
_____ 23. We do not touch electrical things with our hands wet.
_____ 24. We do not keep medicines in the house after we have finished taking the necessary amount.
_____ 25. We do not falsely report an emergency.

Worksheet D2

LIFTING AN OBJECT

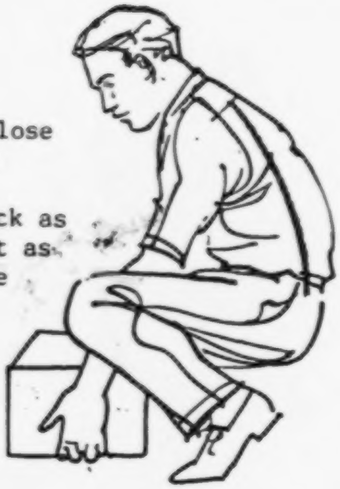
Incorrect Lifting Technique



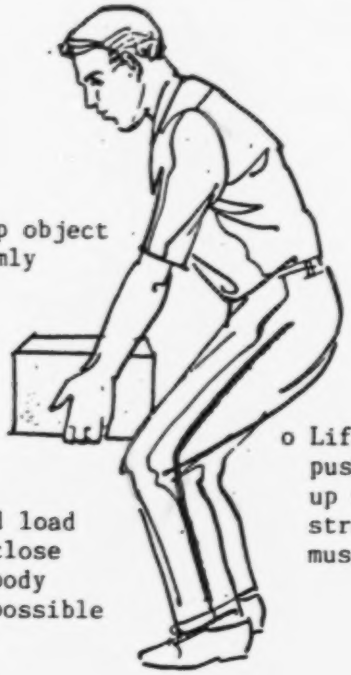
Lift with your leg muscles, not with your back, or your "muscle machinery" may be injured.

Correct Lifting Technique

- o Squat close to load
- o Keep back as straight as possible



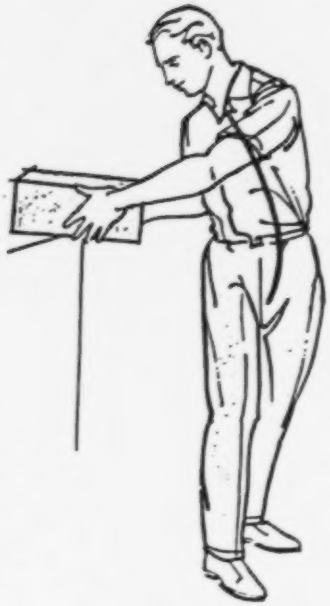
- o Grip object firmly
- o Hold load as close to body as possible



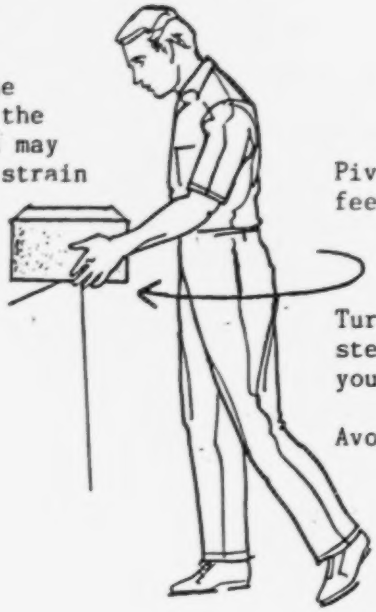
- o Lift by pushing up with strong leg muscles

Worksheet D2a

DIRECTION OF MOVEMENT



Twisting the back pulls the muscles and may cause back strain

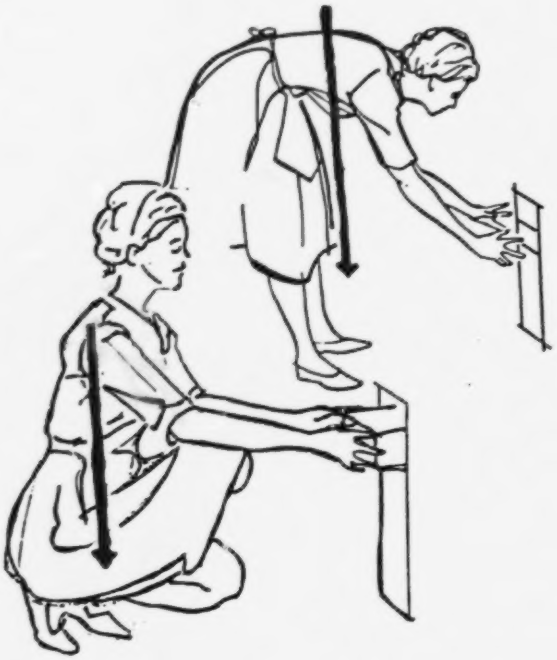


Pivot with your feet

Turn with short steps and turn your whole body

Avoid twisting

Let Your Legs do the Work . . .
Not Your Back



Kneel or squat . . . when you perform a job near the floor. Bend the knees instead of bending from the waist. This saves tiring or straining back muscles.

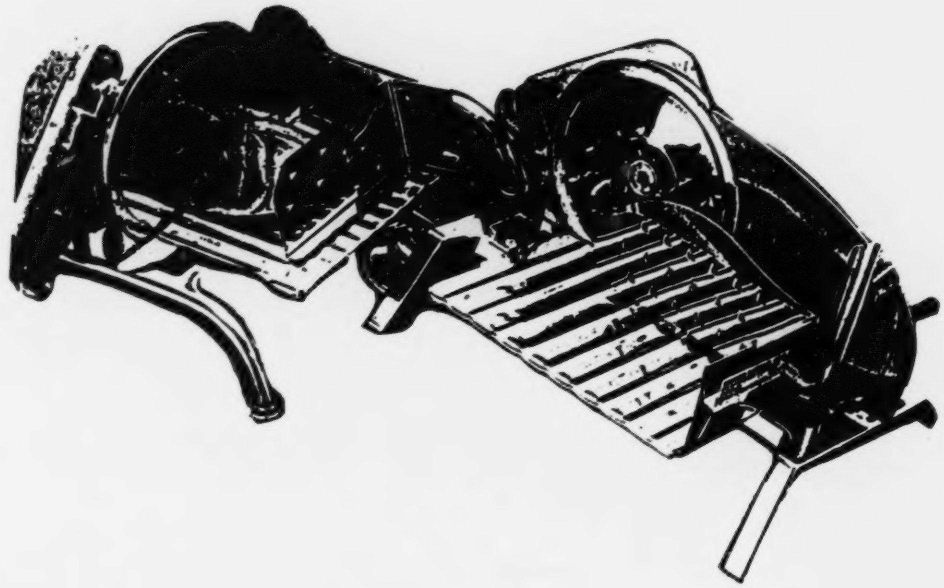
Worksheet F3

SAMPLE KNIVES

Pocket Knives

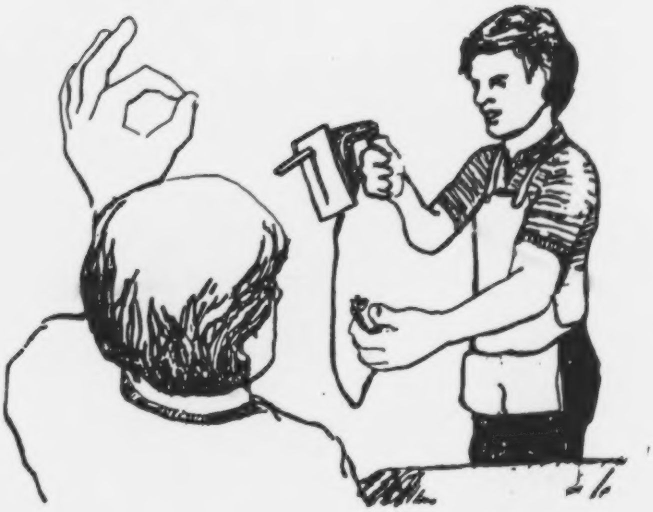
Electric Meat Slicer
or Slicing Knife

Electric Food Slicer

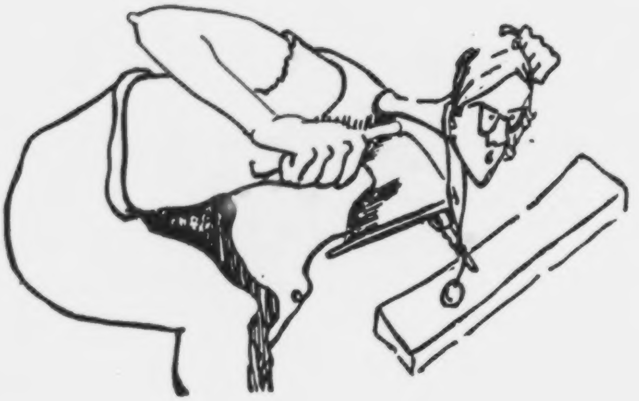


Worksheet G4

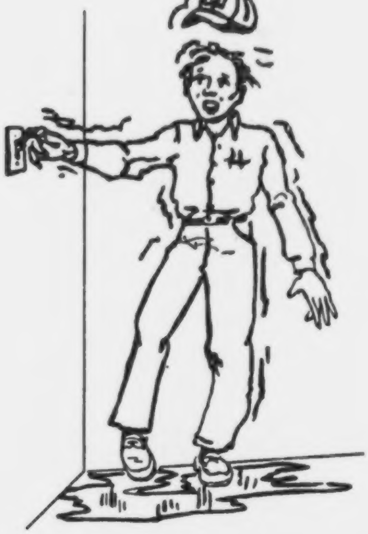
Operate power tools and equipment only after getting approval of the instructor.



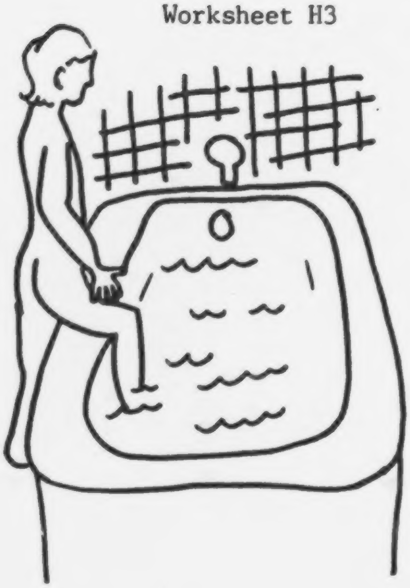
Never wear jewelry when operating power tools or machines.



NEVER switch an electrical device on or off when you are wet or while standing in water. Water conducts electrical current.

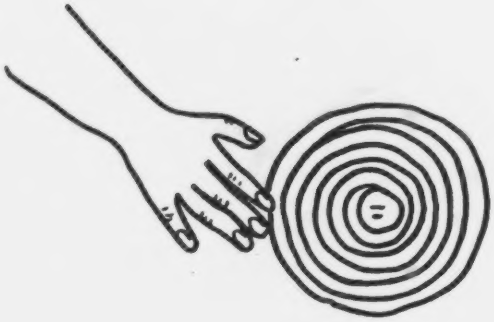


Worksheet H3


Ouch, that's hot!

If the water you stepped into was too hot, what might happen?

What things could you do to prevent a burn from hot water?



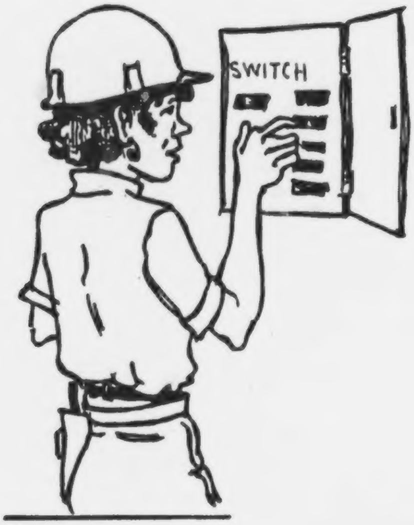
Don't test a stove burner to see if it is hot by putting your hand on it. Check the controls on the stove to see if it's on and hold your hand 6-8" above the burner to feel the heat - not the burner.

What would happen if you put your hand on the burner even if it wasn't red hot?

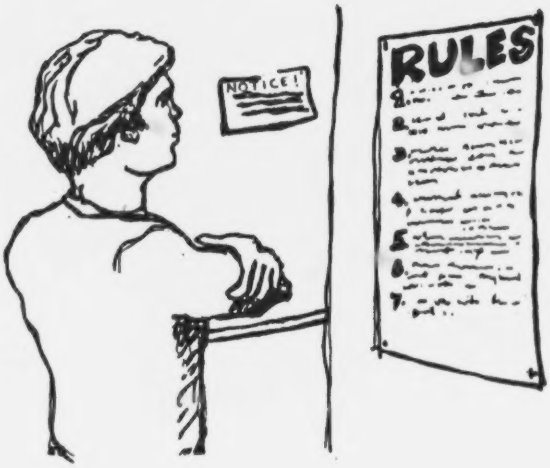
What are some other safety measures you can take to keep yourself and others from being burned by a hot surface like a stove top?

Worksheet J2

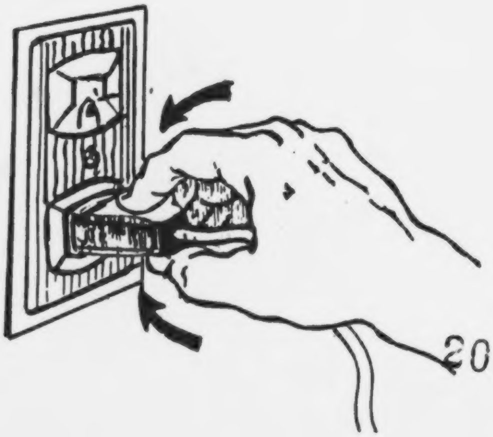
Directions: Match the following actions with the safety instructions which best describe the action to be taken.



ALWAYS unplug electrical cords by pulling the plug instead of the cord. Pulling on the cord can damage the wiring in the plug.



NEVER work on an electrical path or circuit until you have located and disconnected the master switch. The master switch controls power.



Read all safety rules, posters and notices before operating any machine.

INSTRUCTIONAL MODULE

ACCESS SKILL: BECOME FAMILIAR WITH VOCABULARY PERTINENT TO THE APPROPRIATE VOCATIONAL SUBJECT

VOCATIONAL AREA:
Auto Mechanics
Diesel Mechanics
Electronics
Welding

TASK ANALYSIS STEPS: A-B

ACTIVITY	MATERIALS/RESOURCES
TASK A: The student will recognize vocabulary necessary to successfully complete assigned tasks	
1. Students working in pairs or alone may prepare a notebook of appropriate vocabulary and definitions for each unit or an entire year. See Worksheet A1 for suggested requirements.	Worksheet A1 notebook, paper, textbook
2. At the beginning of each unit of study, use a transparency and overlay to identify appropriate sections of a piece of equipment or parts to be studied. After introducing essential vocabulary, remove the overlay and call on specific students to go to the screen to point to a part you select. Repeat the process until every student has identified a section or piece. Next day, distribute copies of the item with numbered lines for parts. Students write in the names of the appropriate parts. Collect papers. Project the transparency and overlay for reinforcement. See (transparency) Worksheet A2 and (overlay) A2a for an example.	Worksheet A2 (transparency) Worksheet A2a (overlay) Overhead projector Screen
3. Make a selected vocabulary list for a unit of study. Worksheet A3 provides an example. Divide students into groups. Distribute vocabulary list and large index cards. Divide the list as equally as possible. Assign each group to locate each word in the textbook or dictionary. Students neatly print the key word on one side of the large index card and the meaning on the opposite side. If the definition needs to be reworded for the students' comprehension, they rewrite it. Next, each group will appoint one speaker. The speaker from each group will teach the class each vocabulary word. Index cards are tacked to a bulletin board or taped to a wall. (Masking tape works well.) Next day, regroup students. Distribute vocabulary lists. Students write a definition for each word. Use the displayed cards to check the papers as a class. Students discuss and rewrite difficult or incorrect responses. Remove the cards from the display. Next day, on a plain sheet of paper, students write the correct vocabulary word as you read the definition from the card. Use all or part of the list.	Worksheet A3 Large index cards textbook or dictionary
4. Use real or model parts. For example, if you are working in welding, show the base metal, gap in seam, bead torch tip, welding rod, and puddle. Write a list of the vocabulary on the board. Use the textbook to identify specific parts. Be sure each student sees the part from the real or model item. Show a specific part, such as the puddle, to the class to identify. Students look up all vocabulary words they miss identifying in their textbooks.	
5. Write a mock purchase order for each student. Distribute the mock orders. Each student will sketch each part or trace it from the textbook. For example, a student might receive the following on a purchase order for a Bent-Axis Pump: piston, piston rod, cylinder, universal link.	Mock purchase order, unlined paper, textbook
6. Scramble a list of vocabulary words. Distribute the list and a list of definitions or pictures. Students unscramble the list and write each word to the left of the appropriate definition or picture. See Worksheet A6 for an example.	Worksheet A6

ACTIVITY	MATERIALS/RESOURCES
TASK A: CONTINUED	
7. Make copies of a picture of an item (such as a Bent-Axis Pump). Draw lines through the copies. Cut the copies to make a puzzle. (If you want to use the puzzle many times, laminate each piece or use clear contact paper over each piece and a piece of cardboard.) Give each student a puzzle to put together, Worksheet A7. After completing the puzzle, students label each appropriate part orally to the instructor. See Worksheet A7a.	Worksheet A7
8. Prepare a vocabulary list for review from the current unit of vocational study. Play hangman with the list. Divide class into two teams. Go only as far as arms and legs on the hangman. Keep a list of used letters on one side of the board for each game. If this is for an automotive class, a simple design of a car or a truck could be used instead of a stick figure of a person.	Blackboard, chalk, Vocabulary list from current unit of study
TASK B: Student will become familiar with concepts of vocabulary necessary to successfully perform assigned tasks.	
1. Cut pictures from magazines or old catalogs of items that use the vocabulary word. Paste each on an index card. Students explain how the key word, written on the board, is used in the item. For example, see Worksheet B1 and Worksheet A3. Students may refer to textbook. After students have adequately explained the vocabulary word for each picture, distribute copies of several pictures for students to write an explanation of the key word for each picture. After completion, students exchange papers, form small groups and discuss responses. Changes are made on students' papers. (Encourage students to write positive comments on papers.) After all papers have been discussed, return papers to owners. Allow time for students to read comments and to ask questions. Next day, write on the board: What purpose does the key word serve in each of the following? Using masking tape, place 3 to 5 pictures on the board and number each one. Students write responses for each picture. Collect papers. Students discuss assignment orally for reinforcement.	Worksheet B1 Worksheet A3 index cards, masking tape, blackboard, chalk, copies of items
2. Write the key words on the board. Students work in pairs to find explanations in their textbooks or dictionaries for each key word. After completion, pairs move into groups of four to compare responses. One member of each group explains one key word to the class.	Blackboard
3. On numbered index cards, write a fill-in item. Tell students there are x number of cards. Distribute one card to each student. Distribute one prepared answer sheet to each student. Place remaining cards on a front desk. As students complete a card using their textbook, they pass it to the next student. Cards from the front desk are used until each student has attempted every card. Papers may be collected for evaluation or checked together in class. If papers are collected, oral reinforcement is necessary. Read each card aloud and students call out responses. See Worksheet B3 for an example of items.	Prepared numbered index cards numbered answer sheets Worksheet B3 textbooks

ACTIVITY	MATERIALS/RESOURCES
TASK B: CONTINUED	
4. Word Rummy - Make a deck of cards from index cards. Laminate them or cover with clear contact paper. Write or print the key word on one card and the definition or concept on another. To play: Students deal five cards to each player. Place remaining cards in the middle of the group of up to four players. Student to the dealer's left begins by drawing the top card from the deck. To make a match, the key word and its correct definition must be used as a pair. If student has a match, he/she places the pair face up on his/her desk, draws again until no further match is made from that hand. If no match is possible, student discards one card from the hand and the next player continues. The winner is the student with the most correct matches. For disputes, students check textbooks for clarification.	Word list from unit in textbook index cards textbooks
5. Select a unit of study to be used in electronics, automotive repair, welding, etc. Students skim reading material in vocational textbook chapter. Students list unfamiliar technical words from the chapter. Each student chooses any ten unfamiliar technical words from the assigned chapter to write on 3" x 5" cards. On a master answer sheet, each student writes the word in alphabetical order with a sentence that defines the technical word. Each student writes his/her name on the back of each card. Students design an appropriate game board, for example, in electronics the game board might be designed as a particular circuit. Game board markers could be made from tag board or cardboard in the shape of items that use the circuit, part of car, tools used in welding, etc. Each student has three face-down cards from his/her vocabulary cards. Each student turns over one card, pronounces the word, and gives an appropriate technical definition. Student to the right checks accuracy of definition by reading the definitive sentence. If student gives correct response, he/she rolls die or a spinner could be used (circular cardboard divided into 6 equal sections with a hole and an upside down brad in the middle, color one split end of the brad for the spinner) to see how many places to move forward on the gameboard. Winner is the student who reaches the end first or the one who is closest to the end at the end of specified time. Students list the words at the end of the master answer sheet or on a record sheet, prepared by the instructor, which need to be learned. Accuracy of 70 percent or higher is the goal for each student in the first game. If new words are added, accuracy of 90 percent or higher should be attained.	Worksheet B6 tag board, felt tipped marker, scissors, 3 x 5 cards, master answer sheet of vocabulary definitions, die or spinner, check sheet, pencils
7. Use Activity 6 with a basic group of technical vocabulary words from the end of a unit in a vocational textbook, for example, or from two or three units of study to provide a review before a test or hands-on task.	

Worksheet A1

DIRECTIONS: Each student will prepare a notebook of vocabulary for this course. At the end of the semester, an open notebook test will be given. Notebooks will be collected for a project grade.

REQUIREMENTS: Write neatly and legibly in blue or black ink. Organize the notebook according to each unit of study. Within each unit, alphabetize each group of words. Sketch on unlined paper or photocopy appropriate items and correctly print the name of each part.

CAUTION: Do not photocopy items and labels. Print the labels. Keep the organized vocabulary in a looseleaf notebook. On the front cover, write your name, class, and instructor's name.

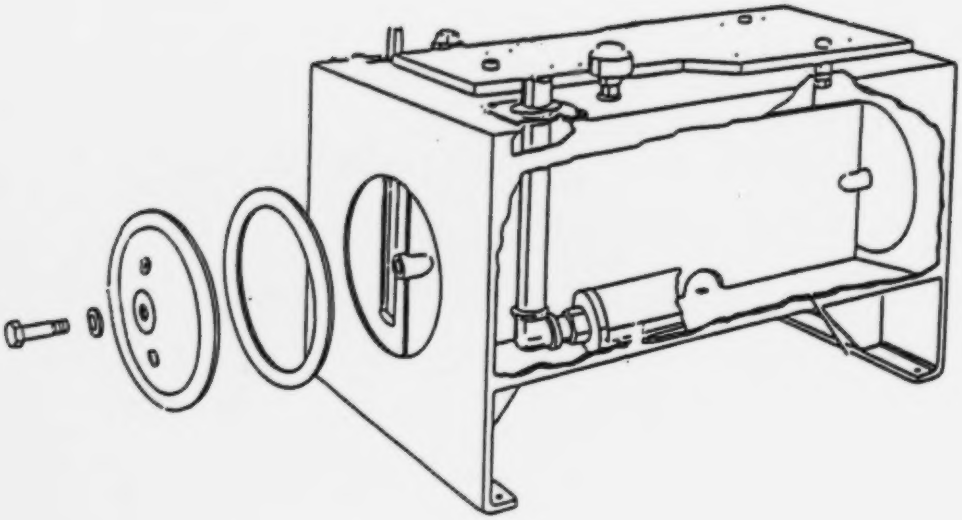
TESTING AND COLLECTION DATE: ________________________

POINTS POSSIBLE FOR: Test __________

Notebook __________

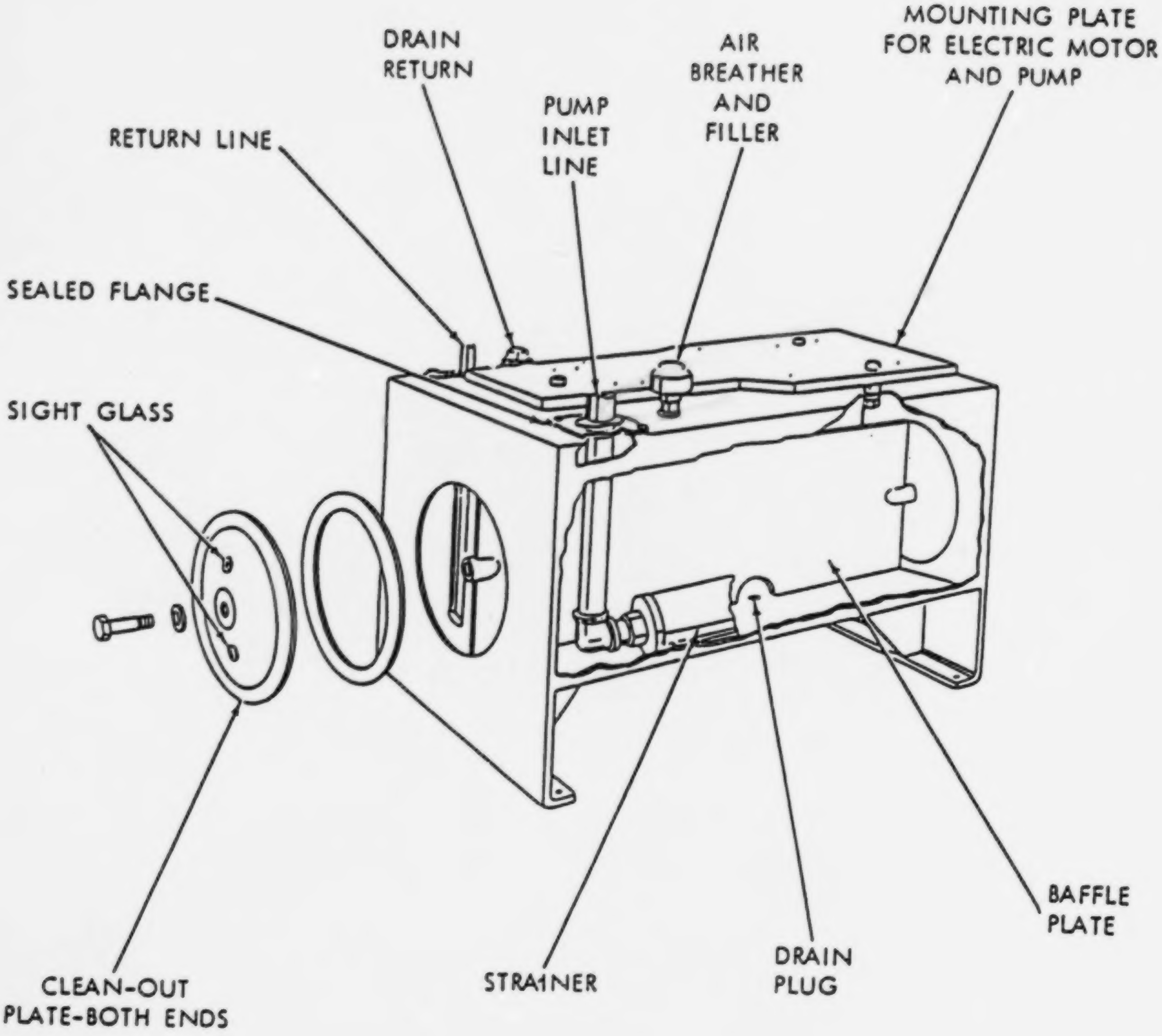
Worksheet A2

TRANSPARENCY



Worksheet A2

TRANSPARENCY OVERLAY


DRAIN RETURN
MOUNTING PLATE FOR ELECTRIC MOTOR AND PUMP
AIR BREATHER AND FILLER
PUMP INLET LINE
RETURN LINE
SEALED FLANGE
SIGHT GLASS
BAFFLE PLATE
DRAIN PLUG
STRAINER
CLEAN-OUT PLATE-BOTH ENDS

Worksheet A3

Analogous colors

Asymmetry

Balance

Compass

Crosshatching

Hue

Isometric drawing

Oblique drawing

Pattern

Proportion

Rhythm

Scale

Schematic diagram

Sections

Symmetry

Tangent

Texture

Tracing

Triad

Unity

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Worksheet A6

I. Unscramble each of the following words. Write them to the right of each item.

A. PHA NI SMAE

B. GEDLNIW ORD

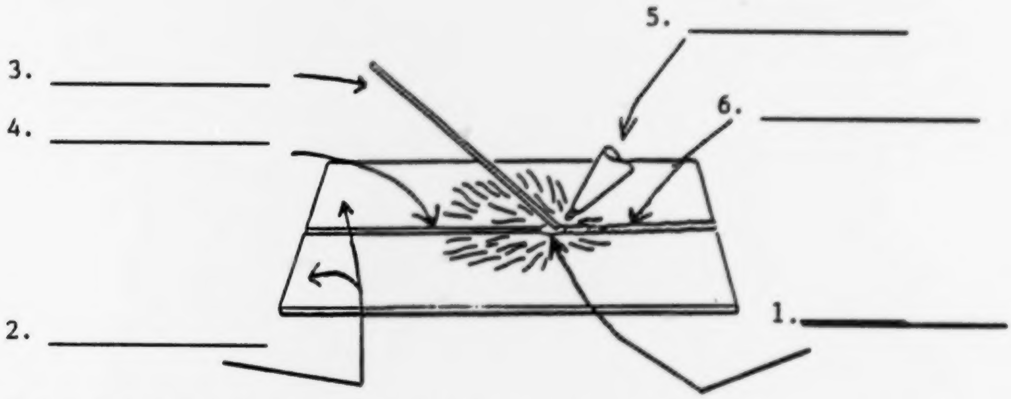
C. EASB TMALE

D. DPLDEU

E. BADE

F. RTCOH IPT

II. Label each part correctly.



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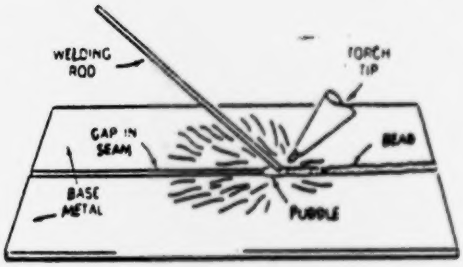
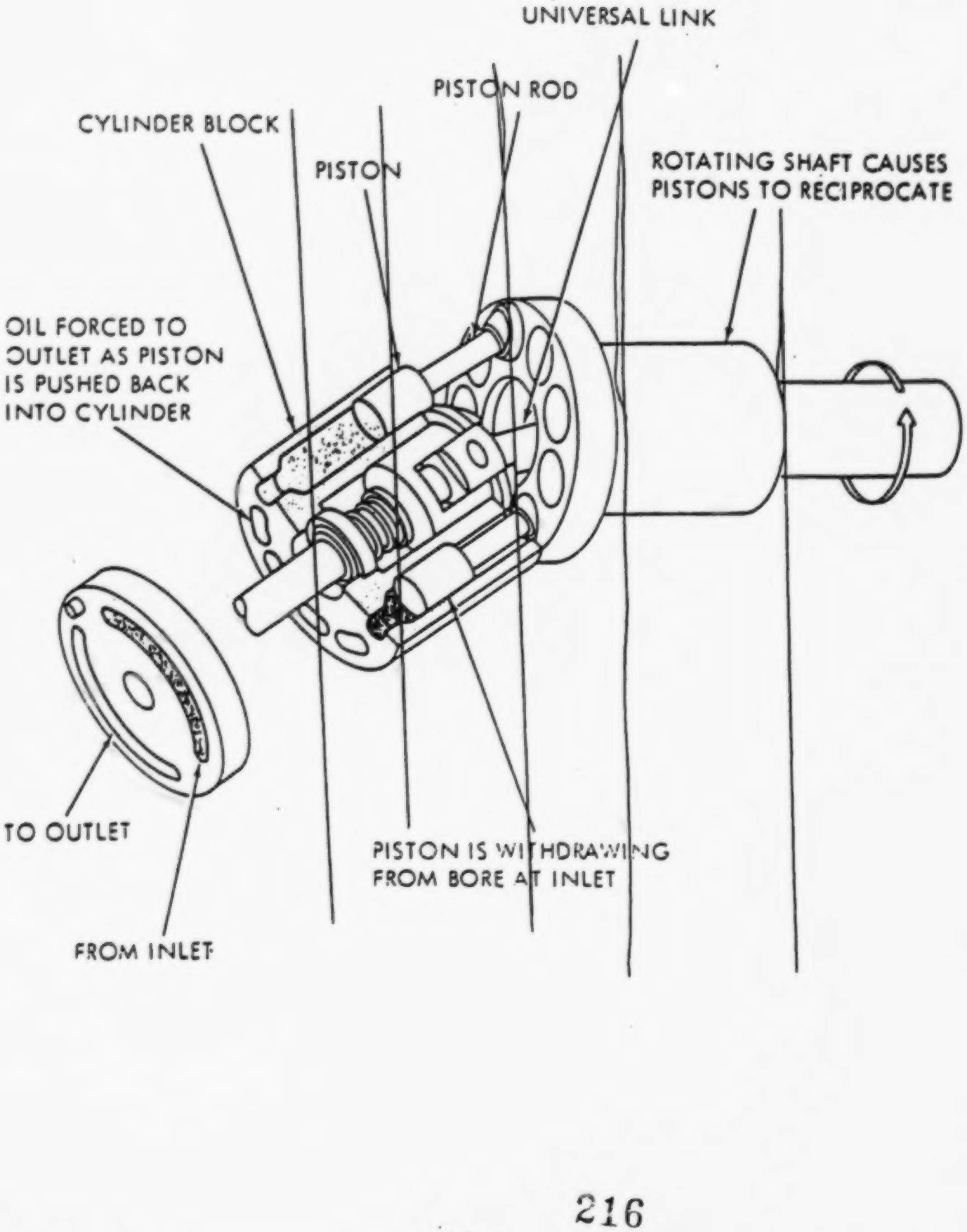
Worksheet A6a Answer Sheet


WELDING ROD
TORCH TIP
GAP IN SEAM
BEAD
BASE METAL
PUDDLE

Worksheet A7


UNIVERSAL LINK
PISTON ROD
CYLINDER BLOCK
PISTON
ROTATING SHAFT CAUSES PISTONS TO RECIPROCATE
OIL FORCED TO OUTLET AS PISTON IS PUSHED BACK INTO CYLINDER
TO OUTLET
FROM INLET
PISTON IS WITHDRAWING FROM BORE AT INLET

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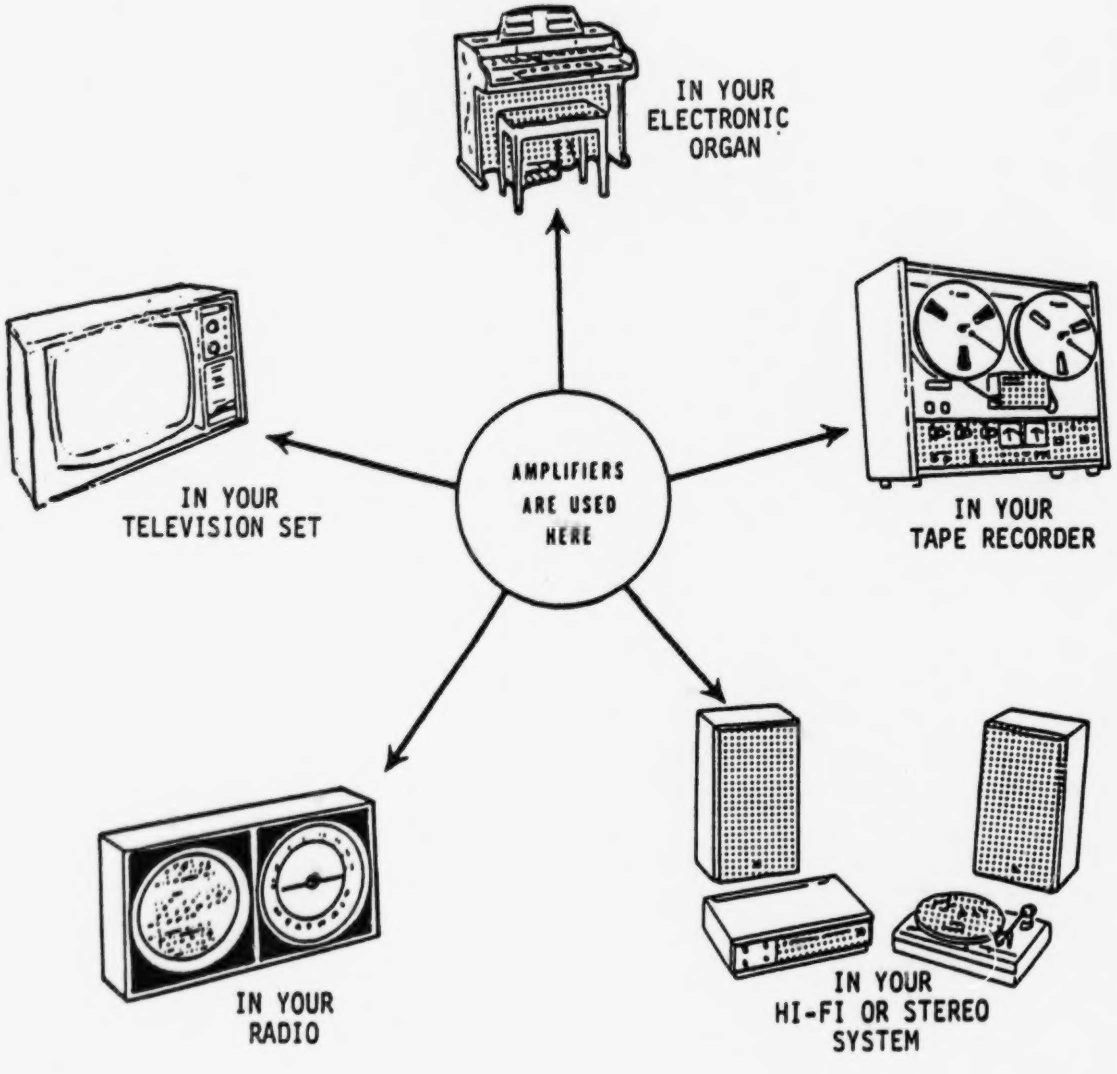
Worksheet A7a

Ask each student to identify each of the following parts by pointing to the specific part on completed puzzle.

1. Cylinder block
2. Piston
3. Piston rod
4. Universal link
5. To outlet
6. From outlet

Worksheet B1

ELECTRONIC CIRCUITS


AMPLIFIERS ARE USED HERE
IN YOUR ELECTRONIC ORGAN
IN YOUR TELEVISION SET
IN YOUR TAPE RECORDER
IN YOUR RADIO
IN YOUR HI-FI OR STEREO SYSTEM

Worksheet Bla

As I show you a picture, I want you to explain how amplifiers are used in the items. (Show pictures)

1. television
2. electronic organ
3. tape recorder
4. stereo system
5. radio
6. two-way radio communication systems
7. radar sets
8. electronic security systems
9. public address or intercom systems
10. telephone

Worksheet B3

This review is prepared in a programmed instruction format. It will enhance your understanding of the material presented in this section. Read each of the numbered frames carefully and fill in the missing blanks at the bottom of each frame. The correct answer appears in parentheses at the beginning of the next frame. Use a sheet of paper to cover all of the frames below the one you are reading.

1. An amplifier is a device that increases the ________ of an electronic signal.

2. (level, magnitude, or amplitude) Most amplifier circuits are designed to faithfully reproduce the shape of a signal and therefore do not intentionally introduce _______ into the signal.

3. (distortion) Most modern amplifiers contain a solid-state component such as a _______ which is capable of providing the necessary amplification.

4. (transistor) In addition to the solid-state component, various resistors, capacitors, and inductors are used to control the operation of the solid-state device and effectively regulate the overall characteristics and stability of the _______ circuit.

5. (amplifier) Basically, all amplifiers can be arranged into two groups according to their use. One type is used to amplify signal voltages and it is therefore referred to as a _______ amplifier.

6. (voltage) The second type is used to amplify the power level of a signal and is therefore referred to as a _______ amplifier.

7. (power) A power amplifier provides power amplification by raising the input signal current to a higher level. This is why a power amplifier is sometimes referred to as a ________ amplifier.

8. (current) Amplifiers may be classified according to their circuit configuration. When a transistor is used in the amplifier, the three possible circuit configurations are the common-______________, common-______________, and common-______________ circuits.

Worksheet B3 Continued

9. (emitter, base, collector) Amplifiers may also be grouped according to their class of operation. The four commonly used classes of operation are class ______________, class ______________, class ______________, and class ______________.

10. (A, B, AB, and C) Another way of classifying amplifiers is by frequency. The operating frequency may extend from zero, in the case of a DC signal, to extremely high frequencies. Five typical examples include ____________ amplifiers, ____________ amplifiers, __________ amplifiers, ____________ amplifiers, and ___________ amplifiers.

11. (DC, audio, video, RF, and IF) Amplifiers are among the most widely used electronic circuits and are found in some of the instruments that are commonly used in the home. Five instruments in the home which use amplifiers are ____________, ____________, ____________, ____________, and ____________.

(radios, television sets, stereo or hi-fi sets, tape recorders, and electronic organs).

Worksheet B6

As wide reading in the content areas expands, the importance of developing recognition of more technical words increases. Content areas include vocabulary words of a technical nature that are not frequently included in other areas of recreational reading.

Time Needed: The following activity requires a total of approximately one hour and 20 minutes.

30 minutes to skim and note vocabulary words
30 minutes for introduction
15 minutes for the game
5 minutes to record and evaluate

Materials:
- Tagboard
- Felt-tipped marker
- Scissors
- Index cards, 3" x 5"
- Master list of vocabulary definitions
- Die
- Paper and pencils

Preparation: Select a given unit of study you will soon be using. Ask students to skim some reading material from that unit of study and jot down unknown words of a technical nature that occur in the reading.

Activity Directions:

Have each student choose any ten words that he or she will concentrate on learning. Additional words can be added when appropriate. Each student writes his or her own words on 3" x 5" cards. Then make up a master answer sheet that has all of the words in alphabetical order with an accompanying sentence that defines each word according to the contest of the unit of study.

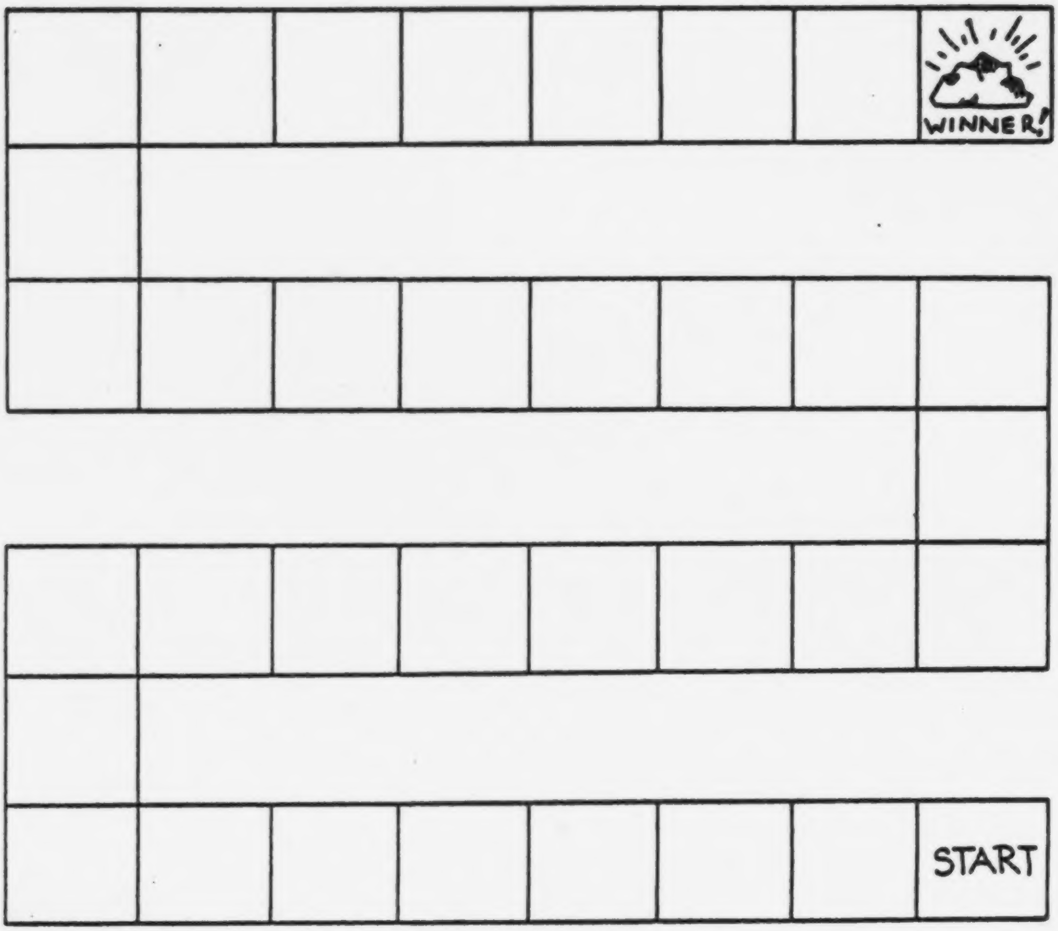
Have the students design a gameboard and title it according to the topic being studied. For example, in studying electronics words, the board might be titled "Buzz Words."

The students should also write their names on the back of each of their word cards. Gameboard markers can be made from the tagboard in the shape of resistors, diodes, etc.

Each player then takes three face-down cards from his or her own vocabulary cards. Alternately, each player turns over one card, says the word, and gives a definition according to the unit of study. The player to the right or a person designated as a "checker" makes sure that the definition is accurate. If the definition is acceptable, the player rolls the die to see how many places to advance forward on the gameboard.

The winner is the player who reaches the golden nugget first or the player who is closest to it at the end of a specified period of time.

Worksheet B6 Continued


WINNER!
START

Worksheet B6 Continued

Culmination of Activity:

Each student uses his or her own list of vocabulary words as a record sheet. A check mark is placed beside each word that was correctly defined in the game. Words that were incorrectly defined are noted at the bottom so that they may receive special attention.

George Todd

Electronic Words

	April 7	April 24	May 4
1. Resistor	✓	✓	✓
2. Transistor			✓
3. Diode		✓	✓
4. Circuit	✓	✓	✓
5.			
6.			
7.			
8.			
9.			
10. Circuit Board	✓	✓	
To be learned:			

Evaluation:

After initial experience with the words during the vocabulary game, students who have scores of 70 percent or higher are successful in this activity. New words may be added when the original ones are mastered with 90 percent or higher accuracy.

Supplementary Activity:

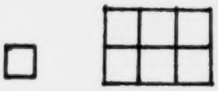
A basic core group of technical vocabulary words for a unit may be selected and used as the common words for all students who use the game.

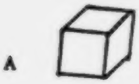
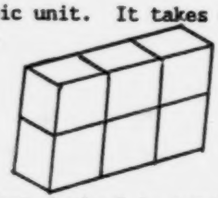
INSTRUCTIONAL MODULE

ACCESS SKILL: FIGURE SQUARE FEET AND CUBIC FEET

TASK ANALYSIS STEPS: A-D

VOCATIONAL AREA:
Auto Mechanics
Carpentry
Diesel Mechanics
Electronics
Machinist
Welding

ACTIVITY	MATERIALS/RESOURCES
TASK A: The student will become familiar with the terms area and volume	
1. Discuss the definition of area and volume. Use squares and blocks or boxes to show students what is meant by the terms area and volume.	Worksheet A1
2. Have the students practice finding the area of various regions. Discuss the fact that a unit triangle, △, can also be used to find area.	Worksheet A2
3. Have the students use graph paper to make regions similar to the ones shown on Worksheet A1. Have them find the areas. Also have students exchange their graph paper with other students and find the areas.	Graph paper, pencil
4. Using graph paper have the students draw various regions. After drawing them have the students compare their regions, noting similarities and differences.	Graph paper Worksheet A4
5. Have the students practice finding the volume of various solid regions.	Worksheet A5
6. Have the students use square blocks or sugar cubes to make solid regions similar to the ones shown in Worksheet A5. Have them find the volume. Have the students find the volumes of each others solid regions.	Square blocks or sugar cubes
7. From a list, have the students devise solid regions using blocks or sugar cubes.	Worksheet A7, sugar cubes or square blocks
8. Divide the students into groups of two. Have one student devise a solid region and have the other student determine the volume. Have the two students exchange places.	Square blocks, sugar cubes
TASK B: Student will become familiar with the terms square unit, square inch, square foot, cubic unit, cubic inch, and cubic foot	
1. Discuss with the students the meaning of square unit using the following example: Think of region A as a square unit. It takes 6 square units to cover the rectangle. 	
Using the regions the student drew in Activity A3 and A4, have the students find the square units of each region.	Worksheets A3 & A4
2. Give the students problems in drawing square units. Have them draw their name in block letters and find the area in square units.	Worksheet B2 graph paper, pencil

ACTIVITY	MATERIALS/RESOURCES
TASK B: CONTINUED	
3. Draw a square inch on the blackboard or on a transparency. Explain to the students that each side measures one inch. Draw a rectangle on the board or transparency that is 6 inches wide and 8 inches long. Separate the rectangle region into square inches. Have the students determine the area in square inches.	
4. Have the students practice drawing rectangular regions, separating the regions into square inches, and finding the area in square inches.	Paper, pencil ruler, Work-B4
5. Divide the students into groups of two. Have them give each other various rectangles to draw and then find the square inches.	
6. Draw a square foot on the blackboard. Explain to the students that each side measures one foot. Draw a rectangle on the board that is 1 foot wide and 2 feet long. Separate the rectangular region into square feet. Have the students determine the area in square feet.	
7. Have the students practice drawing rectangular regions on the blackboard, separating them into square feet, and determining the area in square feet.	Worksheet B7 yardstick, chalk
8. Discuss with students the meaning of cubic unit using the following example: Think of solid region A as a cubic unit. It takes 6 cubic units to cover the solid region.   Using the solid regions the student devised in Activity A7 have the students determine the cubic units of each solid region.	Worksheet A7
9. Give the students problems in devising cubic units. Have them devise the first and last initial of their name and then find the volume in cubic units. (They can be drawn on paper if students desire.)	Worksheet B9 square blocks, sugar cubes, or paper if to be drawn
10. Draw a cubic inch on the blackboard or on a transparency. Explain to the students that each side measures one inch. Draw a solid region on the board that is 6 inches high, 6 inches long, and 6 inches wide. Separate the region into cubic inches. Have the students determine the volume in cubic inches.	
11. Have the students practice drawing solid regions separating them into cubic inches, and finding the volume in cubic inches.	Paper, pencil, ruler
12. Divide the students into groups of two. Have them give each other various solid regions to draw and then find the cubic inches.	
13. Draw a cubic foot on the blackboard. Explain to the students that each side measures one foot. Draw a solid region on the board that is 1 foot wide, 2 feet long, and 1 foot high. Separate the region into cubic feet. Have the students determine the volume in cubic feet.	

ACTIVITY	MATERIALS/RESOURCES
TASK B: CONTINUED	
14. Have the students practice drawing solid regions on the blackboard, separating them into cubic feet, and determining the volume in cubic feet.	Worksheet B14 yardstick, chalk
TASK C: Student will become familiar with and use the formulas for figuring square feet and cubic feet	
1. Discuss with the students the fact that the short way to find the area of a region is to multiply the length times the width. Put the formula, A = l x w on the blackboard. Have the students determine what the A, l, and w represent.	
2. Using various regions and the formula, have students determine what the "l" and the "w" would represent.	Worksheet C2
3. Discuss with the students that the short way to find the volume of a region is to multiply the length times the width times the height. Put the formula, v = l x w x h, on the blackboard. Have the students determine what the v, l, h, and w represent.	
4. Using various regions and the formula, have students determine what the "l", "w", and "h" would represent.	Worksheet C4
TASK D: Student will figure square feet and cubic feet	
1. Using the formula in Task C, have the students determine the area in square feet of certain regions. (Some students may need to use a calculator).	Worksheet D1
2. Cut out the top and bottom of various sizes of boxes. Have students find the area of each box.	Boxes
3. Have the students measure various objects in the classroom and determine the area. Some examples would be, the tops of the teacher's and the student's desks, the blackboard, the floor, and the wall.	Yardsticks, tape measures
4. Have the students measure various concrete and brick objects around school and home and determine the area of each. Some examples include a concrete wall, a brick wall, a concrete walk, the front of a seawall, and a house with a brick front.	Yardsticks, tape measures
5. Using the formula, have the students determine the volume in cubic feet of certain solid regions. (Some students may need to use a calculator).	Worksheet D5
6. Have the students find the cubic feet of various boxes.	Boxes
7. Have the students measure various objects in the room and determine the volume. Some examples would be a file cabinet, a bookcase, books, and the classroom.	Yardsticks, tape measures

Worksheet A1

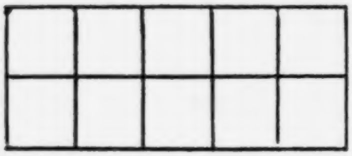
Area: the measure of a region

Volume: the measure of a solid region

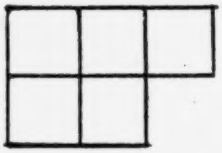
To Find the Area

We can use the unit square, ☐, Find area. Count the number of unit squares to find the area of each region.

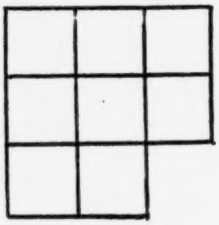
A



B



C

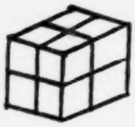


Area = __________ Area = __________ Area = __________

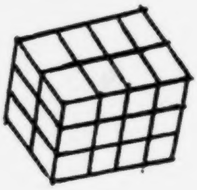
To Find the Volume

We can use a unit cube, , to find volume. Count the number of unit cubes to find the volume of each solid.

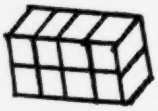
A



B



C

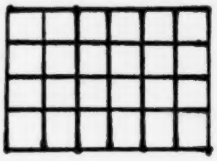


Volume = __________ Volume = __________ Volume = __________

Worksheet A2

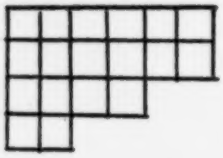
What is the area of each region below?

1.



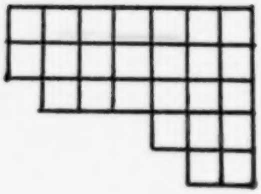
Area = ________

2.



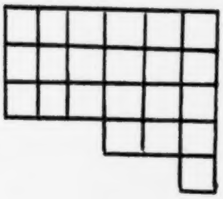
Area = ________

3.



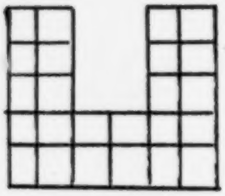
Area = ________

4.



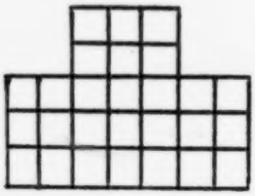
Area = ________

5.



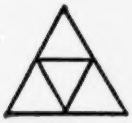
Area = ________

6.



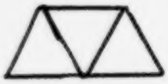
Area = ________

7.



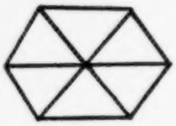
Area = ________

8.



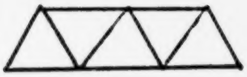
Area = ________

9.



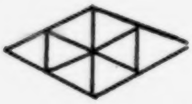
Area = ________

10.



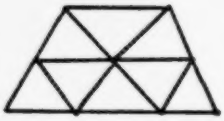
Area = ________

11.



Area = ________

12.



Area = ________

Answer key:

1. 24
2. 18
3. 25
4. 22
5. 24
6. 27
7. 4
8. 3
9. 6
10. 5
11. 8
12. 8

Worksheet A4

Draw the following regions on your graph paper.

1. Draw a region that has 12 units.

2. Draw a region that has 9 units.

3. Draw a region that has 18 units.

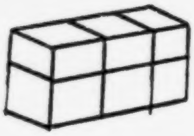
4. Draw a region that has 28 units.

5. Draw a region that has 15 units.

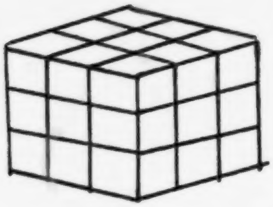
6. Draw a region that has 7 units.

Worksheet A5

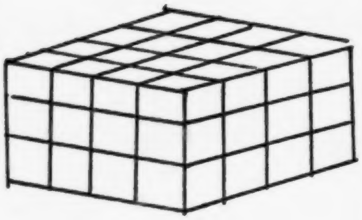
Count the unit cubes to find the volume.

1.


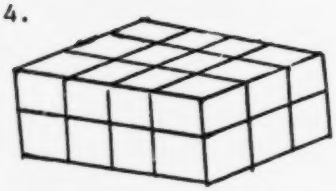
Volume = ______

2.


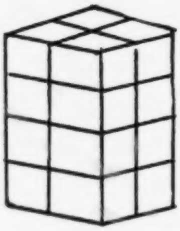
Volume = ______

3.


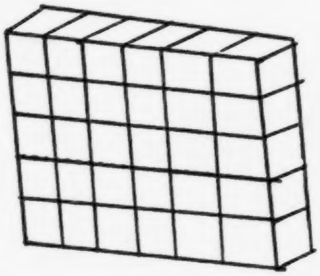
Volume = ______

4.


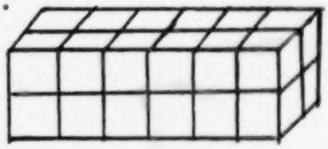
Volume = ______

5.


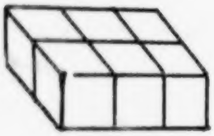
Volume = ______

6.


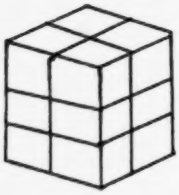
Volume = ______

7.


Volume = ______

8.


Volume = ______

9.


Volume = ______

Answer key:

1. 6
2. 27
3. 48
4. 24
5. 16
6. 30
7. 27
8. 6
9. 12

Worksheet A7

Devise the following solid regions.

1. 10 unit cubes

2. 18 unit cubes

3. 24 unit cubes

4. 8 unit cubes

5. 12 unit cubes

Worksheet B2

Find the number of square units.

1. Draw a rectangle whose region has an area of 16 square units.

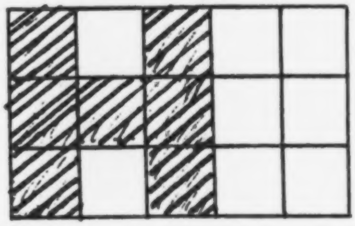
2. Draw a rectangle whose region has an area of 9 square units.

3. Draw two rectangles whose regions have an area of 24 square units.

4. Draw two rectangles whose regions have an area of 12 square units.

5. Draw your name in block letters. Find the area of square units.

Example: H



Worksheet B4

Draw the following rectangles and determine the area in square inches.

1. Draw a rectangle that is 1 inch wide and 6 inches long. Separate the rectangular region into square inches. What is the area of the region in square inches?

2. Draw a rectangle that is 2 inches wide and 4 inches long. Separate the rectangular region into square inches. What is the area of the region in square inches?

3. Draw a rectangle that is 4 inches wide and 2 inches long. Separate the rectangular region into square inches. What is the area of the region in square inches?

4. Draw a rectangle that is 3 inches wide and 5 inches long. Separate the rectangular region into square inches. What is the area of the region in square inches?

5. Draw a rectangle that is 6 inches wide and 3 inches long. Separate the rectangular region into square inches. What is the area of the region in square inches?

Worksheet B7

Draw the following regions and determine the area in square feet.

1. Draw a square that is 2 feet wide and 2 feet long. Separate the square into square feet. What is the area of the square in square feet?

2. Draw a rectangle that is 1 foot wide and 2 feet long. Separate the rectangular region into square feet. What is the area of the region in square feet?

3. Draw a rectangle that is 2 feet wide and 3 feet long. Separate the rectangular region into square feet. What is the area of the region in square feet?

4. Draw a rectangle that is 3 feet wide and 1 foot long. Separate the rectangular region into square feet. What is the area of the region in square feet?

5. Draw a square that is 3 feet wide and 3 feet long. Separate the square into square feet. What is the area of the square in square feet?

Worksheet B9

Find the number of cubic units.

1. Make a solid region that is 8 cubic units.
2. Make a solid region that is 30 cubic units.
3. Make a solid region that is 16 cubic units.
4. Make a solid region that is 20 cubic units.
5. Make your first and last initial of your name. Find the volume of cubic units.

Worksheet B14

Draw the following regions and determine the volume in cubic feet.

1. Draw a solid region that is 2 feet wide, 2 feet long and 2 feet high. What is the volume in cubic feet?

2. Draw a solid region that is 1 foot wide, 2 feet long and 1 foot high. What is the volume in cubic feet?

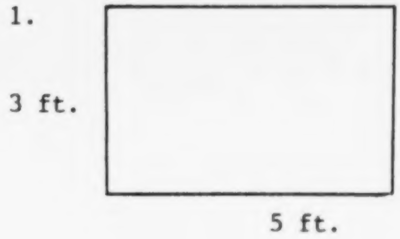
3. Draw a solid region that is 2 feet wide, 1 foot long and 2 feet high. What is the volume in cubic feet?

4. Draw a solid region that is 3 feet wide, 2 feet long and 1 foot high. What is the volume in cubic feet?

Worksheet C2

Fill in the blanks with the correct information.

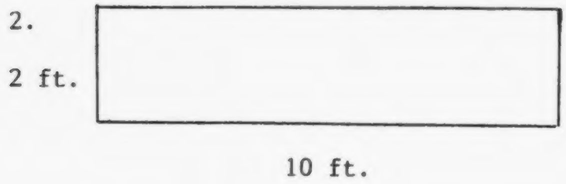
1.



A = l x w

A = ____ x ____

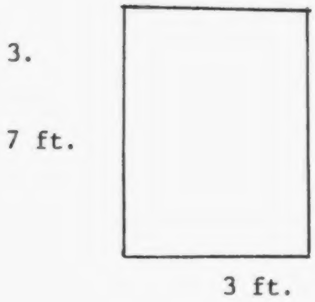
2.



A = l x w

A = ____ x ____

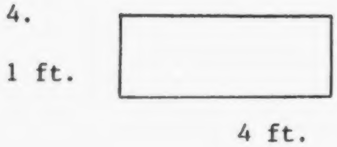
3.



A = l x w

A = ____ x ____

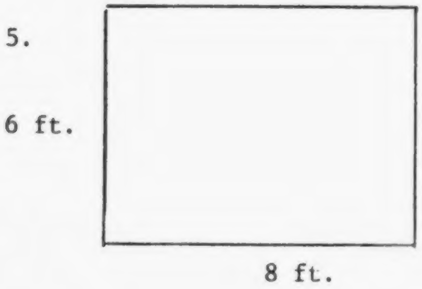
4.



A = l x w

A = ____ x ____

5.



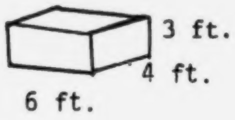
A = l x w

A = ____ x ____

Worksheet C4

Fill in the blanks with the correct information.

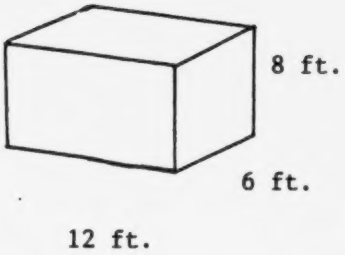
1.



v = l x w x h

v = ___ x ___ x ___

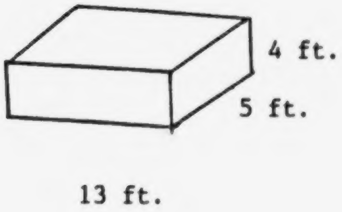
2.


8 ft.
6 ft.
12 ft.

v = l x w x h

v = ___ x ___ x ___

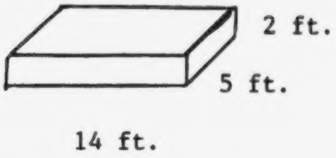
3.


4 ft.
5 ft.
13 ft.

v = l x w x h

v = ___ x ___ x ___

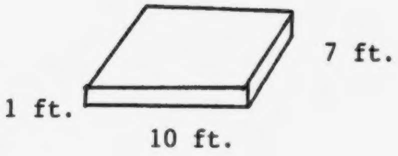
4.


2 ft.
5 ft.
14 ft.

v = l x w x h

v = ___ x ___ x ___

5.


7 ft.
1 ft.
10 ft.

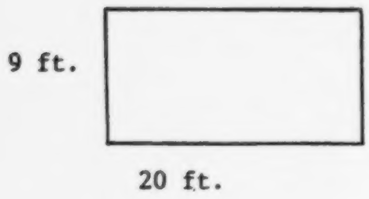
v = l x w x h

v = ___ x ___ x ___

Worksheet D1

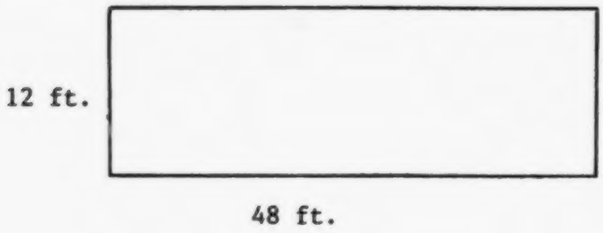
Find the area using the formula, A = 1 x w.

1.



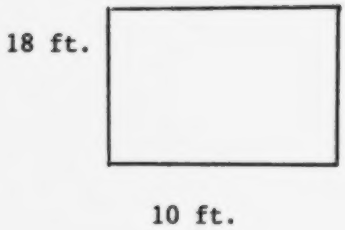
A = ________

2.



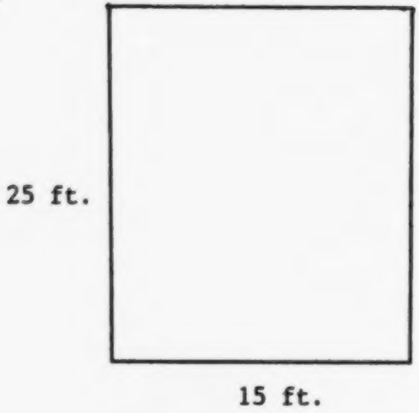
A = ________

3.



A = ________

4.



A = ________

5. Tom wants to mark the edge of his driveway with bricks. It needs to be 25 feet long and 1 foot wide. What is the area? ________

6. Bill wants to place bricks on one wall of the family room. The wall is 10 feet high and 30 feet wide. What is the area? ________

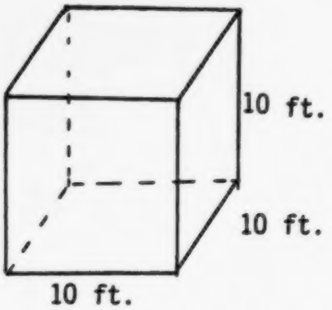
Answer Key:

1. 180 sq. ft.
2. 576 sq. ft.
3. 180 sq. ft.
4. 375 sq. ft.
5. 25 sq. ft.
6. 300 sq. ft.

Worksheet D5

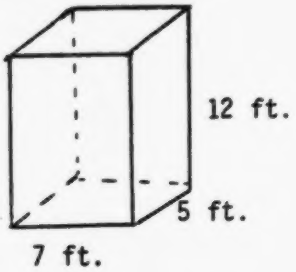
Find the volume using the formula, v = l x w x h.

1.



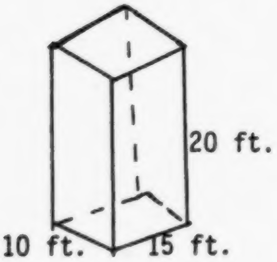
v = ________

2.



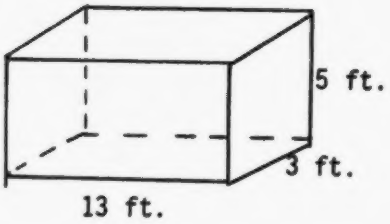
v = ________

3.



v = ________

4.



v = ________

5. Jim is building a seawall. It is 25 feet long, 1 foot wide, and 3 feet high. What is the volume? ________

6. The hearth on the fireplace must be 2 feet high, 4 feet long and 3 feet wide. What is the volume? ________

7. The brick posts at the end of the driveway need to be replaced. Each post is 3 feet long, 2 feet wide, and 5 feet high. What is the volume? ________

8. How many cubic feet of bricks are needed to fill the hole in the wall? It is 8 feet long, 2 feet wide, and 6 feet high. What is the volume? ________

Answer Key:

1. 1000 cu. ft.
2. 420 cu. ft.
3. 3000 cu. ft
4. 195 cu. ft.
5. 75 cu. ft.
6. 24 cu. ft.
7. 30 cu. ft.
8. 96 cu. ft.

INSTRUCTIONAL MODULE

ACCESS SKILL: STUDENT WILL BE ABLE TO IDENTIFY AND USE COMMON HAND TOOLS SAFELY

TASK ANALYSIS STEPS: A - H

VOCATIONAL AREA:
Auto Body
Auto Mechanics
Carpentry
Diesel Mechanics
Heating and Air Conditioning
Welding

ACTIVITY	MATERIALS/RESOURCES
TASK A: Student will identify and correctly name common hand tools	
1. Give student pretests to find what tools are known to the student.	Pretest A and B
2. Obtain various hand tools. Tape the names of the tools on them. Have the students practice naming the tools. After the students can identify the tools with names on them, remove the names and have students again practice naming the tools.	Screwdriver, hammer, pliers, saw, wrench, file, chisel, etc.
3. Give the students pictures of tools, or develop worksheets from a wood shop textbook. Review the various tools with the students.	Worksheets A2a-A2d; Cabinet Making and Millwork
4. Have the students develop a card file of common hand tools. Using catalogs, magazines and/or store advertisements, have the students find pictures of common hand tools. Have the students place the pictures on 3 x 5 cards. Then write the name of the tool and how it's used on the back. Divide the students into groups of two. Have them ask each other to identify each tool.	Worksheet A3 catalogs, magazines, store advertisements, scissors, glue, 3 x 5 cards
5. Give each student a picture of several hand tools. Have them match the tool with its name.	
6. Give students a worksheet with all of the tools names. Label the tools A-T and display them on a table. Ask the students to put the correct letter that appears on each tool next to its proper name on the worksheet. Be sure to go over the names with each student individually (if possible) to be sure the students recognize and understand how to read each. (See Worksheet C1.)	Worksheet A5, pencils, tools, and labels for each tool
TASK B: Student will identify safety rules to follow in handling hand tools	
1. Discuss with the students that the next step to using the tools is to learn the safe handling of each tool. Demonstrate the safety techniques involved in the use of each and allow the students to demonstrate to each other in pairs. Remind the students to keep the noise down so you can listen for anyone who needs help (this will also possible prevent the children from getting careless when handling the tools).	Tools
2. Divide the students into two groups. Have one group list safety rules to follow in using a screwdriver, hammer, and pliers. Have the other group list safety rules to follow in using a saw, wrench, file and chisel.	Worksheet B2
3. Have the industrial arts teacher demonstrate proper maintenance procedures in caring for hand tools. Have the students practice these procedures under the supervision of the industrial arts teacher.	Industrial Arts teacher

ACTIVITY	MATERIALS/RESOURCES
TASK B: CONTINUED	
4. Have each student role play an industrial arts teacher explaining safety rules to follow in using a specific hand tool and the proper maintenance procedures. Have each student select a different hand tool.	Common hand tools
5. Have the children write the names of each tool on large cards and as you hold up the name, ask them to tell you the things they need to remember when handling that tool safely and why.	Large cards, pens
6. Split the students into pairs or very small groups and watch them demonstrate the correct use of each of the tools listed. Be sure each student does it exactly right without assistance before going on to another tool. You may want to use a check-off list to check off which students can correctly use which tools.	Tools, checkoff list, pencil
7. Have the students design a safety poster that shows the correct way to use a hand tool.	
TASK C: Student will select the correct hand tool for a specific task	
1. Have the industrial arts teacher show the correct hand tool used for specific tasks. Have the industrial arts teacher name specific tasks and have students identify the correct hand tool to be used.	Industrial Arts teacher
2. Give the students a specific function of a hand tool and have them identify the correct tool.	Worksheet C2
3. Divide the students into groups of two. Have one student role play the teacher. He names a tool and the other student lists tasks the tool can be used for. After an appropriate length of time have the students exchange places.	
4. Introduce the students to the various pieces of hardware such as nuts, bolts, and screws and the correct tool for the job to be performed.	Nuts, bolts, screws, nails, hand tools
5. Prepare a list of various tasks. Have students identify the correct hand tool and the hardware to complete the task.	Worksheet C5
6. Show the student a picture of an object (tool) and have him/her match its use as written on a worksheet.	Worksheet C6
7. Lead the students in a discussion as to how everybody is different even though we are all people. "When I say the word 'house' you all think of a house, but each house that you picture is probably different. It is the same with tools. If I say the word 'tools' you all think of different ones. Even things like screwdrivers we know are different even though they are screwdrivers. We are going to talk about how each of these tools are different - in looks, material they are made of, weight, length, uses, etc. Who can tell me the difference in a standard screwdriver and a Phillips screwdriver?" (Allow the students to discuss the differences in a few tools and then follow up with Worksheet F1.)	Worksheet C7

ACTIVITY	MATERIALS/RESOURCES
TASK D: Student will be able to set or adjust the tool for proper use and determine correct sizes of fasteners or hardware	
1. Have the industrial arts teacher demonstrate methods of adjusting tools such as the open-end adjustable wrench, vise-grip pliers, socket set, pneumatic wrenches, drills, etc. Then have the students practice adjusting the tools.	Industrial Arts teacher, hand tools
2. Acquire various sizes of nuts and bolts. Have students assemble them.	Nuts and bolts
3. Have various sizes of holes drilled in several boards. Have the students assemble nuts and bolts in the holes.	Boards with holes, nuts and bolts
4. Assemble various sizes of combination wrenches. Give the student a specific size and have him locate it in his set of wrenches.	Combination wrenches
5. Using the nuts and bolts attached to the board in Activity 3, have students find the correct combination wrench that fits the bolt.	Board from Activity 3, combination wrenches
6. Assemble various sizes of sockets and socket wrenches. Have students fit the socket wrench on the sockets.	
TASK E: Student will correctly use common hand tools	
1. Give each student two boards with several holes drilled in them (or use the board from Task D, Activity 3). Also give each student various sizes of nuts and bolts and a screwdriver. Have the students bolt the two boards together. Have the students evaluate each others work.	Board with holes, nuts, bolts, screwdriver
2. Give each student a hammer, two 3-foot long 2" x 4" boards, and an assortment of nails. Have the students nail the boards together in the middle and at each end. Variation of this activity would be to give the students a specific length and have them drive a nail. Give each student a copy of the directions.	Worksheet E3 hammers, nails, 3-foot long 2" x 4" boards
3. Give each student a board with protruding nails. Have the students remove the nails.	Boards with nails protruding, hammer
4. Give each student a 2' by 4' board with holes, screws, and a screwdriver. Have the students screw the screws into the board. Have the students evaluate each others work. After the screws are in the board have the students remove them. Use both standard screwdrivers and Phillips screwdrivers.	2' x 4' boards with holes, screws, screwdrivers
5. Give each student a board with a set of nuts protruding from it and a set of combination wrenches. Instruct the students to tighten the nuts.	Boards with nuts protruding, combination, wrenches
6. Give each student a 3-foot long board. Instruct the students to saw a 1-foot long piece off the board. Have the students evaluate each others work for straightness of cut and neatness in work.	3-foot long boards, saws, rulers
7. Give each student a set of pliers, and short lengths of various sizes of wire and lumber scraps. Have the students practice holding these with the pliers.	Pliers, wire, lumber scraps

ACTIVITY	MATERIALS/RESOURCES
TASK F: Student will return tools to their proper location after use	
1. Discuss with the students the purpose of replacing the tools in their proper location after each use. (In order to make it easy for the next person to locate that tool, to keep the shop neat, etc.)	
2. Using a pegboard, assign a small group of students to place the tools in a specific location on the pegboard. The other group could make tags for each tool to identify the tool, and another group might make tags for the location, so when a tool is removed the person using it will know where to replace it.	Pegboard, tools, small tags with string, small sticky tags, pens, pencils
3. Remove all of the tools from the board once it is completely set up and labeled. Ask the students to replace each of the tools - one tool per student. Then later on ask each student to replace all of the tools without assistance. Whenever working after this, the student should be expected to return the tools to their proper location or possible lose the opportunity to use the tools for a day or so.	Tools, pegboard
Follow-up: Let the parents know what the students have been doing in the class and ask for their cooperation by having the children make a similar pegboard display of the tools they have at their house and label each space and each tool. Ask the parents to make sure the student is actually returning the tool to its proper location each time.	Pegboard, tags, pens, Note to parents
TASK G: Student will demonstrate use of each of the tools studied with no assistance	
1. If at all possible, ask the industrial arts instructor in your school or an interested parent to help out on this day. Ask each student to demonstrate briefly the correct use (including safety and returning the item to its proper place) of each tool we have studied.	
2. As a class, decide on 3 or 4 small projects they would like to build using the tools we have studied (birdhouse, doll-house, a wheelbarrow, etc.) Gather the materials needed to construct each project from parents or possibly the P.T.A. and allow the students enough time to complete the projects.	Wood and various materials as determined by the projects selected
Follow-up: Invite all of the parents in for an opportunity to see all of the projects the students have made. Assign the students each a tool to demonstrate - to tell its use, safety reminders, differences in that tool and another similar tool, etc.	Invitations for parents, completed projects, tools
TASK H: Student will identify the tools needed to build small objects or repair parts without assistance	
1. Discuss with the students the need to know which tools to gather when deciding to build or repair objects.	
2. Have the students think of things they would like to build or repair and see how many tools they can accurately select in order to repair that object.	

ACTIVITY	MATERIALS/RESOURCES
TASK H: CONTINUED	
3. Tell the students you want to build certain objects, and ask them to gather the tools necessary to do so. Then show them pictures of that completed object and check to see how many of the correct tools they would choose. Discuss any errors explaining why you would or would not choose a particular tool. For instance, you would not need a screwdriver to build a birdhouse which is put together with nails and no screws.	Pictures of small items to build (puppet theatre, birdhouse, tool box, etc.)

PRETEST A

Tell the student:

I am going to show you some tools and I want you to name them. You will be allowed 10 seconds to answer correctly and your first answer will be the answer I will accept. Are you ready?

Then either show the student the tools (if you have access to the following tools), or show them the pictures of tools. You may want to make copies of the following pictures and either cut them out and laminate them onto small index cards for identification use, or to be used in any of the other portions of the module. Do not give the student any hints as to what the tool is. Do not tell him/her what the tool does (that is in the second half of the Pretest). Show only one tool at a time (cover the others with a piece of cardboard or cut on the dotted lines between the pictures, so the tools will not be visible after the student has named them). Time the student as in the directions you gave him/her. The student should answer the following:

_____A. hack saw ("saw" is acceptable)
_____B. utility knife ("knife" is acceptable)
_____C. hammer (curved claw)
_____D. pencil
_____E. pliers
_____F. wrench
_____G. standard screwdriver ("screwdriver" is acceptable)
_____H. Phillips screwdriver (must say "Phillips screwdriver)
_____I. socket wrench (must say "socket wrench")
_____J. long nose pliers (must say "long nose pliers")
_____K. scissors
_____L. calculator
_____M. safety glasses ("glasses" is acceptable)
_____N. trowels
_____O. hoe
_____P. file
_____Q. rake
_____R. shovel
_____S. diagonal cutter
_____T. tape measure

__________ Total correct out of 20

Once the student has answered this portion of the test, go on to the second portion asking the student how to use each of the tools.

PRETEST B

Say to the student:

I am going to name some tools and you must tell me their most common use. I will accept you first answer only and you have 20 seconds to answer each one.

"Tell me, what is the most common use for a:

A. Saw: ______________________________(Student response)

Response should be: It is used to cut things like wood, metal, etc. Students must give any of these examples for it to be correct.

B. Hammer: ____________________________(Student response)

Response should be: Used for driving and pulling nails.

C. Pliers: ____________________________(Student response)

Response should be: Used to grip small pieces of wire, wood or metal.

D. Standard Screwdriver: _________________(Student response)

Response should be: Used to install and remove slotted screws.

E. Socket Wrench: ______________________(Student response)

Response should be: Used for holding and turning nuts, bolts, pipes, etc.

F. Scissors: ___________________________(Student response)

Response should be: Used for cutting things like paper and materials.

G. Safety glasses: _______________________(Student response)

Response should be: Used for eye protection.

H. Hoe: ________________________________(Student response)

Response should be: Used for cutting up weeds and loosening up the earth in the fields.

I. Rake: _______________________________(Student response)

Response should be: A tool to gather things together - like leaves, scraps, etc.

J. Diagonal cutter: ______________________(Student response)

Response should be: Used to cut wire, and looks like a needle nose pliers without the nose.

K. Utility knife: ______________________________(Student response)

Response should be: Used to cut and trim small pieces of wood and plastics.

L. Pencil: ______________________________________(Student response)

Response should be: Used for marking or writing.

M. Wrench: ______________________________________(Student response)

Response should be: Used to tighten nuts and bolts, etc.

N. Phillips screwdriver: ________________________(Student response)

Response should be: Used to install and remove cross slotted screws.

O. Long nose pliers: ____________________________(Student response)

Response should be: Used to cut wire and hold small objects.

P. Calculator: __________________________________(Student response)

Response should be: Used to compute figures or add, subtract, multiply and divide in order to find the correct answer.

Q. Trowel: ______________________________________(Student response)

Response should be: Used for spreading. smoothing or scooping plaster, soil, etc.

R. File: ____(Student response)

Response should be: Used for sharpening metal objects such as a knife or a blade of some sort.

S. Shovel: ______________________________________(Student response)

Response should be: Used to lift and move material such as dirt, snow, gravel, etc.

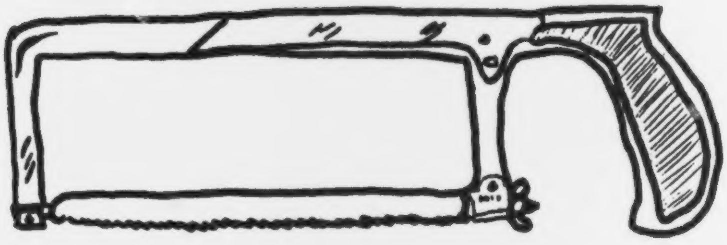
T. Tape measure: ________________________________(Student response)

Response should be: Used to find the length of any object usually up to 10 feet.

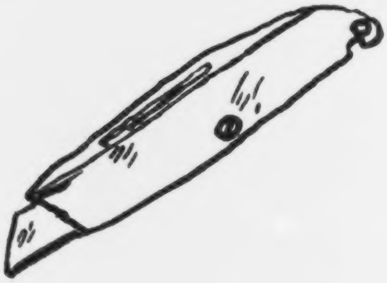
Total points ____________ out of 20

If at all possible you might want to ask the student to demonstrate the use of each of these tools for you in their proper and most common use. The tools can usually be borrowed from either a workshop or industrial arts instructor within the schools.

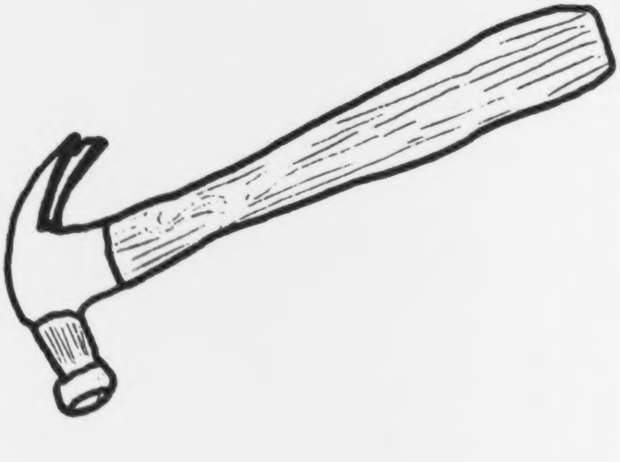
PRETEST PICTURES



A. ______________________________

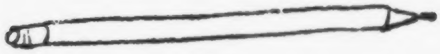


B. ______________________________

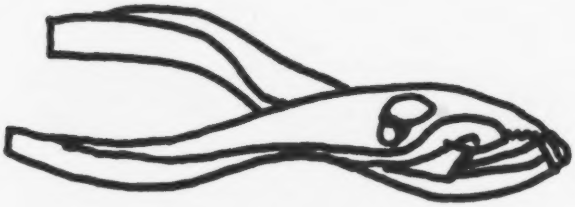


C. ______________________________

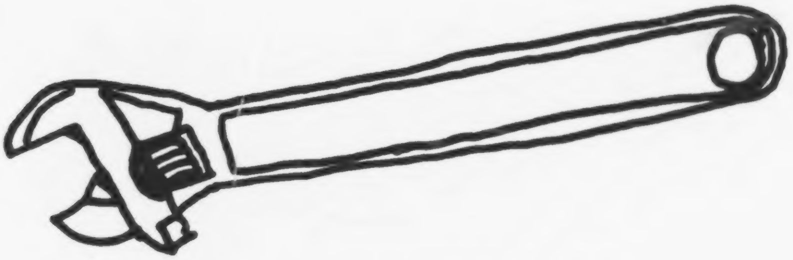
PRETEST PICTURES



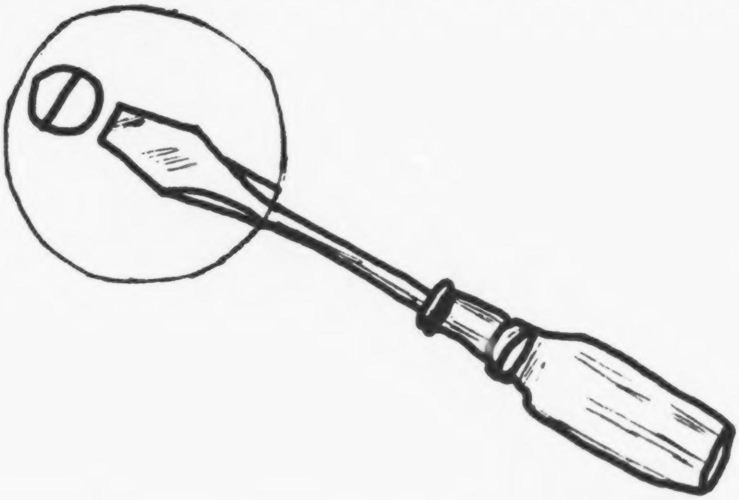
D. ______________________________



E. ______________________________



F. ______________________________



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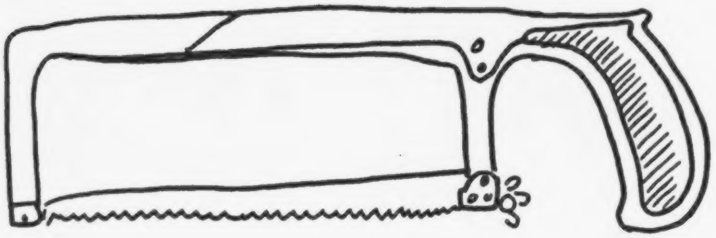
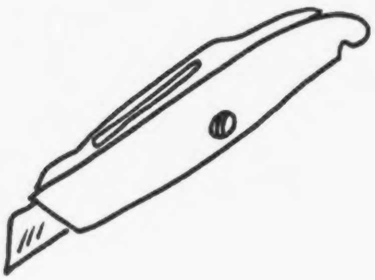
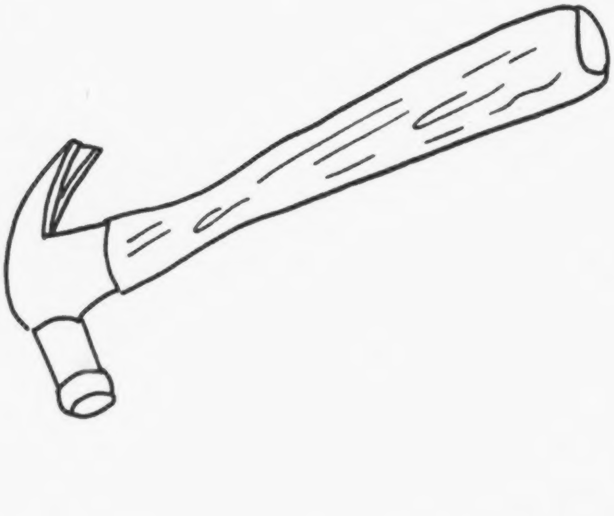
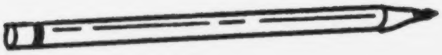
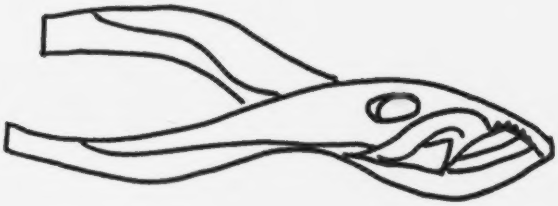
G. ______________________________

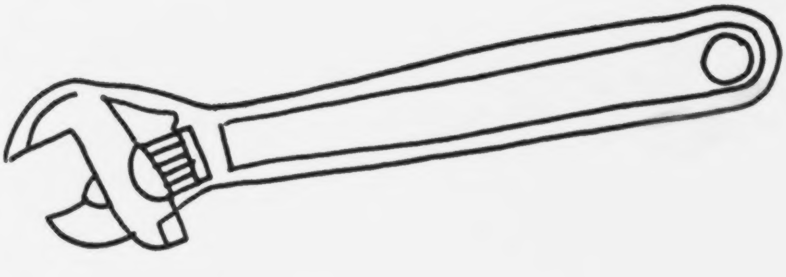


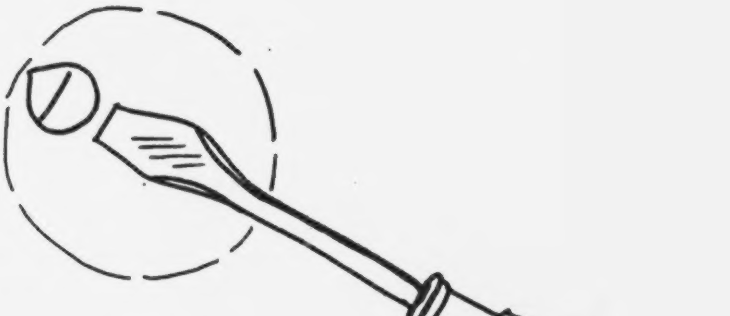






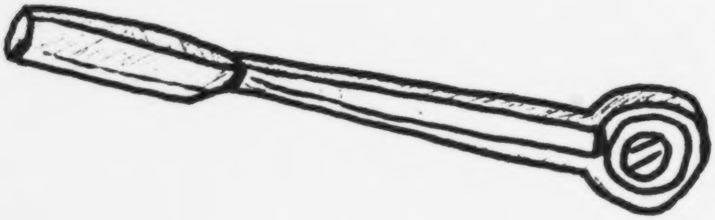






PRETEST PICTURES

H. ______________________________



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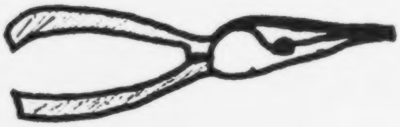

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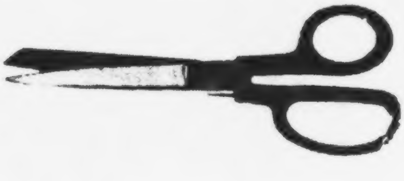

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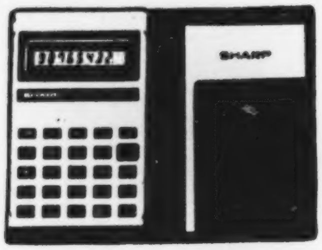

L. ______________________________

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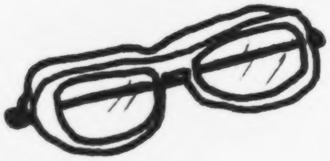

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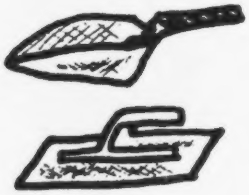

N. ______________________________

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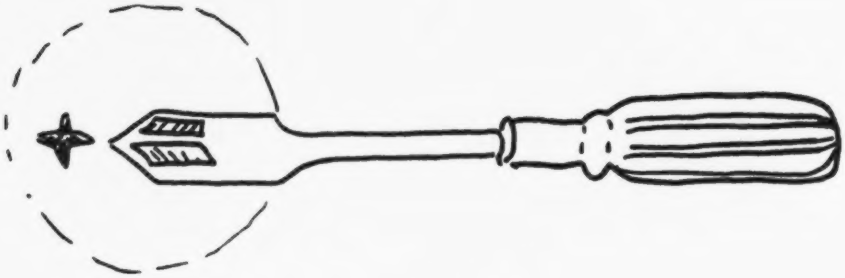
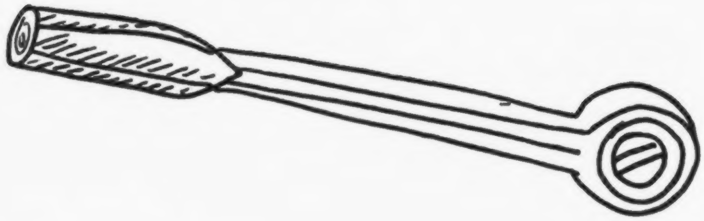
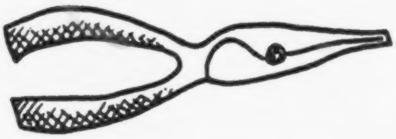
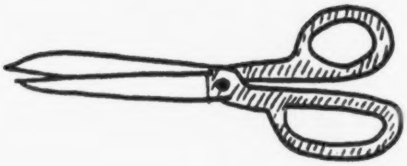
O. ______________________________









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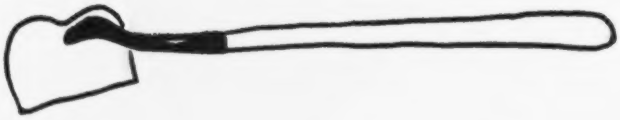

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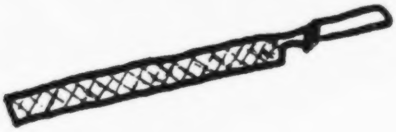

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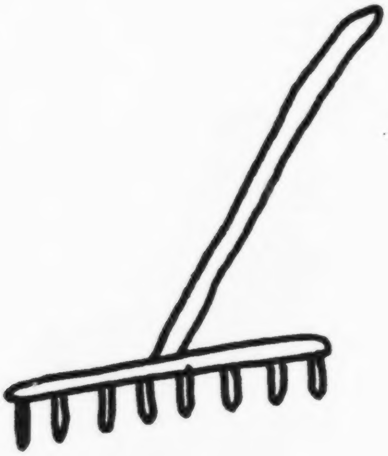

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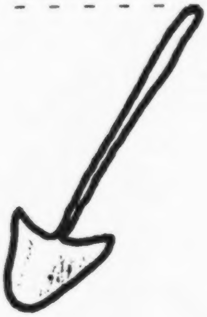

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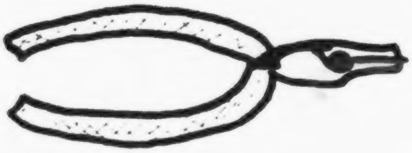

S. ______________________________ 258

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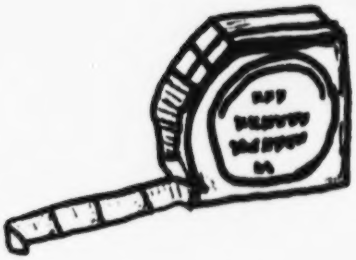
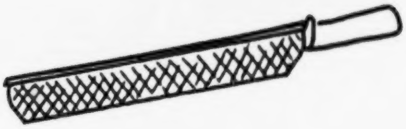
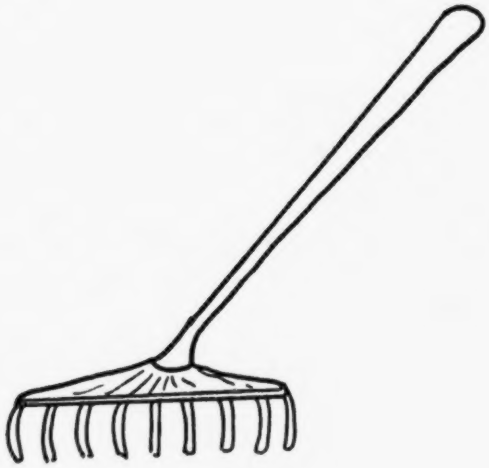
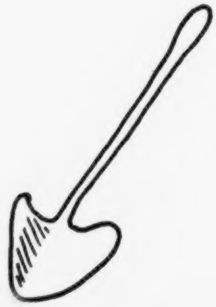
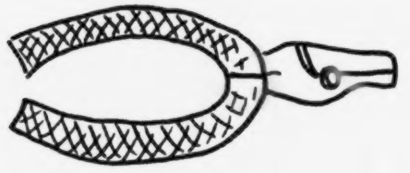


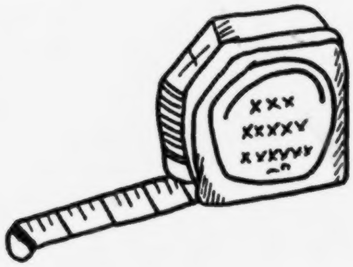
T. ______________________________





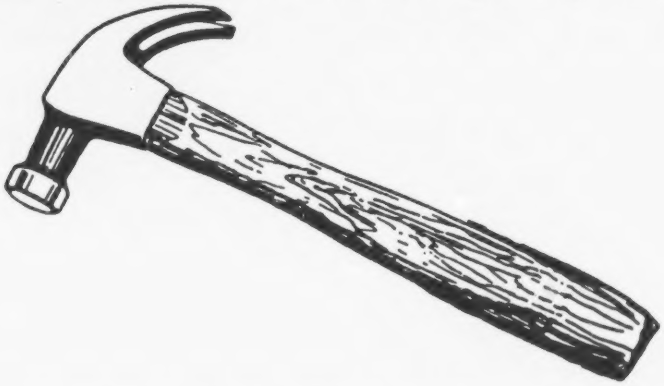




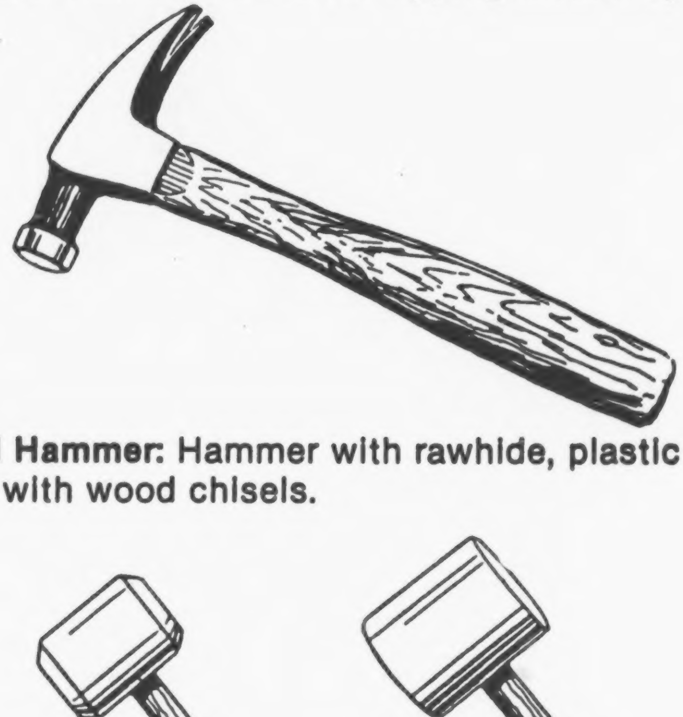


Worksheet A2a

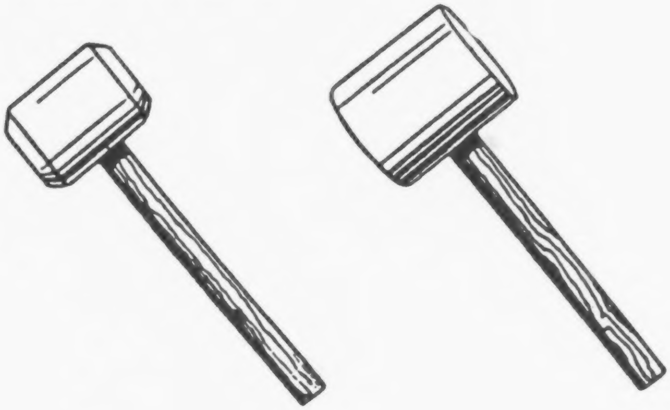
1. **Curved Claw Hammer:** Used for driving and pulling nails.



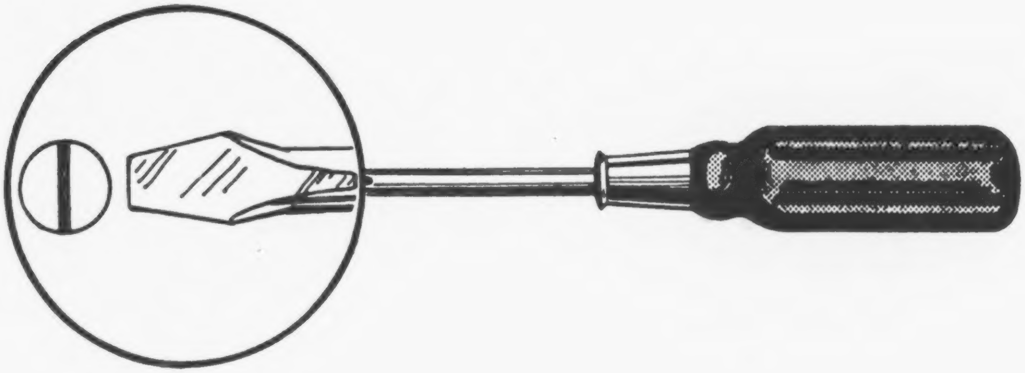
2. **Straight Claw Hammer:** Used for ripping lumber apart.



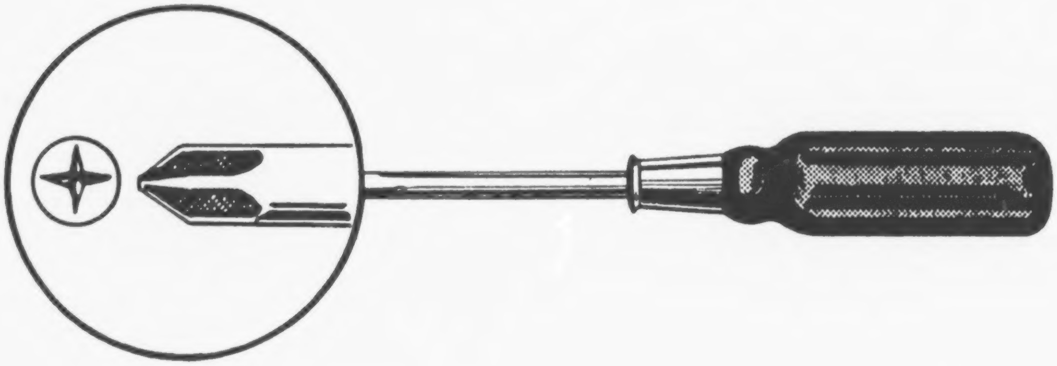
3. **Soft Faced Hammer:** Hammer with rawhide, plastic or wood head used with wood chisels.



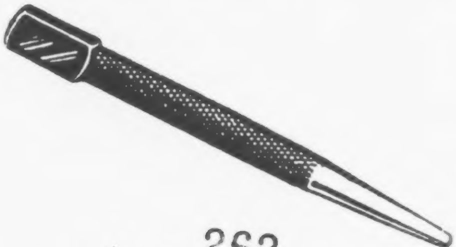
4. **Standard Screwdriver:** Used to install and remove slotted screws.



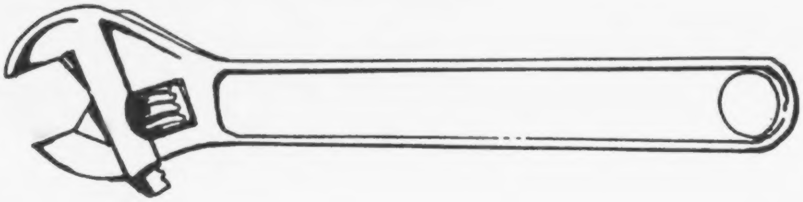
5. **Phillips Screwdriver:** Used to install and remove cross slotted screws.



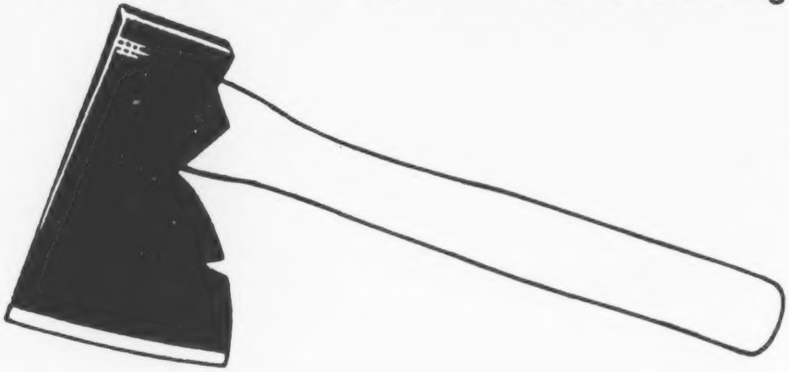
6. **Nail Set:** Used with the hammer to sink nail heads into wood.



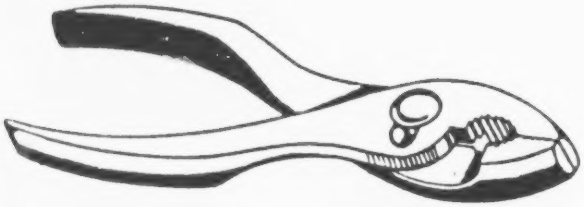
7. **Adjustable Wrench:** Used to remove and install nuts and bolts.



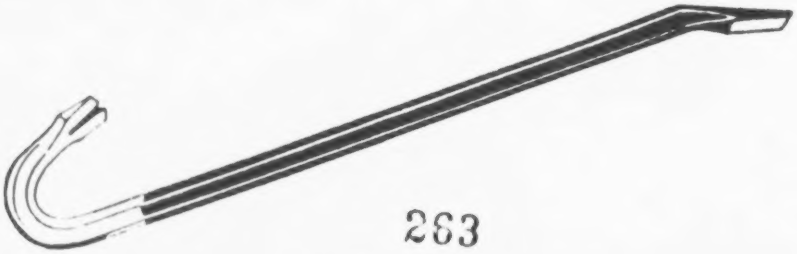
8. **Hatchet:** Used to trim wood pieces and nail flooring.



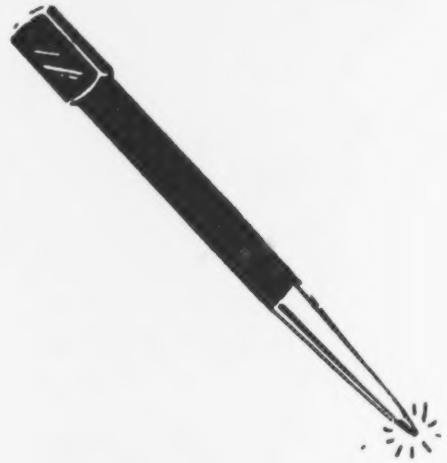
9. **Pliers:** Used to grip small pieces of wire, wood or metal.



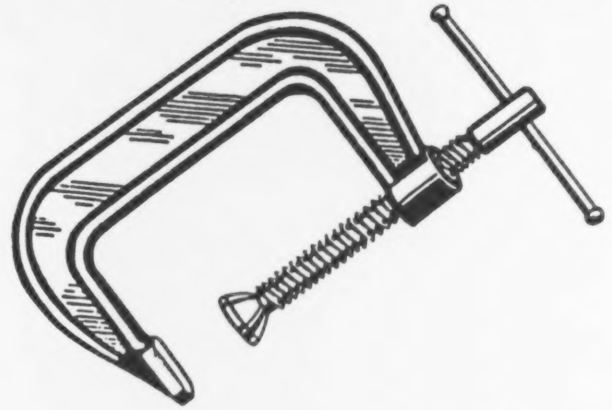
10. **Ripping Bar:** Used to strip concrete forms, pry lumber and pull nails.



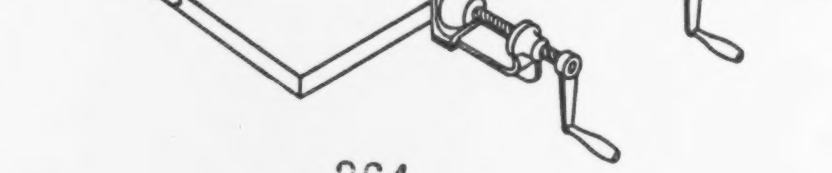
11. **Center Punch:** Used for marking the center of a hole to be drilled.



12. **C-Clamp:** Adjustable device used to hold wood or metal.



13. **Bar Clamp:** Used to assemble products and hold glued edges.



Worksheet A3

COMMON HAND TOOLS

Curved Claw Hammer

Straight Claw Hammer

Soft Faced Hammer or Mallet

Standard Screwdriver

Phillips Screwdriver

Nail Set

Adjustable Wrench

Combination Wrench

Socket Wrench

Hatchet

Combination Pliers

Round-nose Pliers

Ripping Bar

Center Punch

C-Clamp

Bar Clamp

Chisel

File

Saw

Hacksaw

Coping Saw

Worksheet A5

Directions: Find all of the tools on the table in the back of the room. Read over the names of each of the tools on this worksheet. If you do not recognize the name of one of the tools, be sure to ask your teacher before you begin to complete this worksheet.

Walk by the tools on the table and decide what the first tool is and put the letter that appears on that tool next to the name of the tool on this sheet.

For example: If the first item on the table was a hammer, and had an A beside it, I would put an A on the blank line next to the word hammer.

_____ tape measure
_____ diagonal cutter
_____ shovel
_____ rake
_____ file
_____ hack saw
_____ utility knife
_____ hammer
_____ pencil
_____ pliers
_____ wrench
_____ standard screwdriver
_____ socket wrench
_____ long nose pliers
_____ scissors
_____ calculator
_____ safety glasses
_____ trowels
_____ hoe
_____ Phillips screwdriver

Total correct _______

To the teacher:

Display only the items listed above on a table in the back of your classroom and label each tool with the letters A to T. Allow the students approximately 15 minutes to match all of the items with their name and then grade their answers or have the correct name on the back of the label for them to self-check.

Worksheet B2

Safety Rules in Using a Screwdriver

1. Use the correct size screwdriver for the screw being handled.
2. When driving or removing a screw, hold the screwdriver square with the screw and guide the tip with your free hand.
3. A screwdriver is not a substitute for a chisel or to be used as a pry.
4. Do not use a screwdriver in which the tip is worn.

Safety Rules in Using a Hammer

1. Do not use a hammer unless the head is on tightly and the handle is solid.
2. Knuckles can be injured if you "choke up" too far on the handle when striking a blow.
3. Unless the blow is struck squarely, the hammer may glance off the work.

Safety Rules in Using Pliers

1. Do not use pliers as a substitute for a wrench.
2. Use pliers large enough for the job.
3. Clean and oil pliers frequently.
4. Store pliers in clean, dry place.
5. The jaws may become deformed if the tool is used on an object that is larger than the tool's designated capacity.

Safety Rules in Using a Saw

1. Do not test the sharpness of the blade by running your finger across the teeth.
2. Be sure the blade is properly tensioned.
3. Store the saw so you will not accidently reach into the teeth when you pick it up.
4. Apply enough pressure on the forward stroke to make the teeth cut.
5. Be sure to keep the blade cutting in a straight line.

Safety Rules in Using a Wrench

1. The movable jaw should always face the direction of the rotation.
2. Always pull on a wrench. You have more control over the tool if pulling instead of pushing and there is less chance of injury.
3. Select a wrench that fits properly.
4. Never hammer a wrench to loosen a stubborn fastener.

Worksheet B2 Continued

Safety Rules in Using a File

1. Apply just enough pressure to permit the file to cut on the entire forward stroke.
2. The work must be held solidly for effective filing.

Safety Rules in Using a Chisel

1. Hold the chisel in such a manner that if you miss a stroke with the hammer it well not strike your hand.
2. When using a chisel, wear safety goggles.
3. Do not use a chisel in which the chisel head is mushroomed.

Worksheet C2

Read the function of a tool and then name the tool that goes with it.

1. _____ Used to grip small pieces of wire, wood, or metal.
2. _____ Used to hold wood or metal.
3. _____ Used for driving and pulling nails.
4. _____ Used to remove and install nuts and bolts.
5. _____ Used to install and remove slotted screws.
6. _____ Use for ripping lumber apart.
7. _____ Used when a smooth finish is desired.
8. _____ Used for cutting curved shapes.
9. _____ Used to install and remove cross-slotted screws.
10. _____ Used to sink nail heads into wood.

A. Coping Saw
B. Adjustable Wrench
C. Nail Set
D. Standard Screwdriver
E. C-Clamp
F. Straight Claw Hammer
G. Combination Pliers
H. Phillips Screwdriver
I. File
J. Curved Claw Hammer

ANSWER KEY

1. G
2. E
3. J
4. B
5. D
6. F
7. I
8. A
9. H
10. C

Worksheet C5

Read the task. Decide what hand tools and hardware are needed to complete the task.

1. You want to hang a picture on the wall.
2. The teacher needs a bookshelf with two shelves.
3. One side of the blackboard has come loose from the wall.
4. You need to remove the rivets from a metal cabinet.
5. The water pipe is leaking.
6. The wrought iron railing has a rough, sharp spot on it.
7. You need to take the old bookshelves apart.
8. You need to put the wrought iron chair together.
9. You need to reattach the clothesline wire to the post.
10. You need to remove the long nails protruding from the board.

ANSWER KEY

1. hammer, nail
2. saw, hammer, nails, nail set
3. screwdriver, screw
4. chisel
5. wrench
6. file
7. straight claw hammer
8. nuts, bolts, wrench
9. pliers
10. ripping bar

Worksheet C6

Directions: Watch as your teacher shows you pictures of objects one at a time. You are to match that object with the use of the object on the lines below.

Used to mark or write ____________________

Used to tighten nuts, bolts, etc. ____________________

Used to install and remove cross slotted screws ____________________

Used to cut wire and hold small objects ____________________

Used to compute figures or add, subtract, multiply and divide in order to find the correct answer ____________________

Used for spreading, smoothing or scooping plaster, soil, etc. ____________________

Used for sharpening metal objects such as a knife or a blade of some sort ____________________

Used to lift and move material such as dirt, snow, gravel, etc. ____________________

Used to find the length of any object up to 10 feet in length usually ____________________

Used to cut things like wood, metal, etc. ____________________

Used for driving and pulling nails ____________________

Used to grip small pieces of wire, wood or metal ____________________

Used to install and remove slotted screws ____________________

Used for holding and turning nuts, bolts, pipes, etc. ____________________

Used for cutting paper or cloth material ____________________

Used for eye protection ____________________

Used for cutting weeds and loosening up the earth in the fields ____________________

Used to gather things together - like leaves, scraps, etc. ____________________

Used to cut and trim small pieces of wood and plastics ____________________

Used to cut wire, and looks like a needle nose pliers without the nose ____________________

Total correct ______________

Worksheet C7

Directions: On this page, you will find two tools named in each group. You are to match the letter in front of the tool with the use of the tool in the right hand column. Some tools will be used for more than one of the possibilities.

Example: a. hammer
b. screwdriver

__b__ You can install with this tool
__a__ You can install a nail with this tool
__a__ You can remove nails with this tool

1. a. hack saw
b. diagonal cutter

_____ It can cut objects
_____ It can cut through bolts

2. a. hammer
b. pencil

_____ You can pound things with this tool
_____ You can pound nails into a wall with this tool
_____ You can draw with this tool

3. a. pliers
b. wrench

_____ You can hold small items with this tool
_____ You can turn nuts and bolts with this tool
_____ You can twist small pieces of wire with this tool

4. a. standard screwdriver
b. Phillips screwdriver

_____ You can install and remove screws
_____ You can install and remove slotted screws
_____ You can install and remove cross-slotted screws

5. a. socket wrench
b. long nose pliers

_____ You can hold small objects with this tool
_____ You can cut wire with this object

6. a. scissors
b. utility knife

_____ You can cut wood and plastics with this tool
_____ You can cut paper with this tool
_____ You can cut this item

7. a. safety glasses
b. calculator

_____ You wear this item for working safely
_____ You can wear this item

8. a. trowels
b. hoe

_____ You can smooth plaster with this tool
_____ You can dig in your garden with this tool

Worksheet E3

Follow these directions.

1. Measure over 1 1/2 feet and drive a nail into the board.
2. Measure over 2 feet 7 1/2 inches and drive a nail into the board.
3. Measure over 1 foot 3 3/4 inches and drive a nail into the board.
4. Measure over 8 1/4 inches and drive a nail into the board.
5. Measure over 2 feet 2 3/8 inches and drive a nail into the board.
6. Measure over 1 foot 9 7/8 inches and drive a nail into the board.
7. Measure over 4 5/16 inches and drive a nail into the board.
8. Measure over 2 feet 10 13/16 inches and drive a nail into the board.

INSTRUCTIONAL MODULE

VOCATIONAL AREA:
Drafting
Electronics
Offset Lithography

ACCESS SKILL: IDENTIFY PRIMARY, SECONDARY AND INTERMEDIATE COLORS AND USE IN COLOR WHEEL

TASK ANALYSIS STEPS: A-F

ACTIVITY	MATERIALS/RESOURCES
TASK A: Student will discriminate between two colors.	
1. Before instructing student in this skill, determine his/her color knowledge as follows: a. Have student touch something in the room using a primary color as per teacher's instruction. b. Teacher should name an object in the room and have the student give the color of the object.	
2. Use flashcards of varying shades of colors. Put similar colors beside each other and ask the student to tell if they are the same or different.	20-40 cards with different shades of colors on them with an identical set of cards for comparison
3. Use a double set of cards with two identical shades of each color. Put two similar colors together part of the time and two cards of the same color together the rest of the time. Ask the student to tell if they are the same or different.	
4. If student cannot discriminate between similar shades of color, use different colors. Use first intermediate colors with a primary color, but if those colors cannot be distinguished from the same colors, then use a primary and a secondary. Last, if the student still has not been 100% successful, use two primary colors.	
TASK B: Student will match like colors.	
1. Use color flashcards. Have student sort the two sets into identical pairs.	Flashcards in colors
2. Have student sort markers, pencils, crayons, paints, etc. into sets of one color.	Small colored items for sorting
3. Use worksheets with one color on the left and one on the right. Have student list everything in the room that is the same color as the top circle under the appropriate side.	Color worksheets
4. Have students take turns finding everyone in the room who has on the same color as his/her shirt, slacks, etc.	
5. Make up worksheets as a class by using magic markers or colored pencils and putting two circles of each color somewhere on the page, then exchanging papers and having the students draw lines to match the two identical colors.	
TASK C: Student will identify primary, secondary, neutral colors.	
1. Make flashcards with color names in black on one side and name written in the color itself on the other side. Have each student make his/her own set of flashcards using a chart on the bulletin board with colors and their names listed.	Tag board for making cards for color names; Paints and magic markers for writing color names on one side in the appropriate color

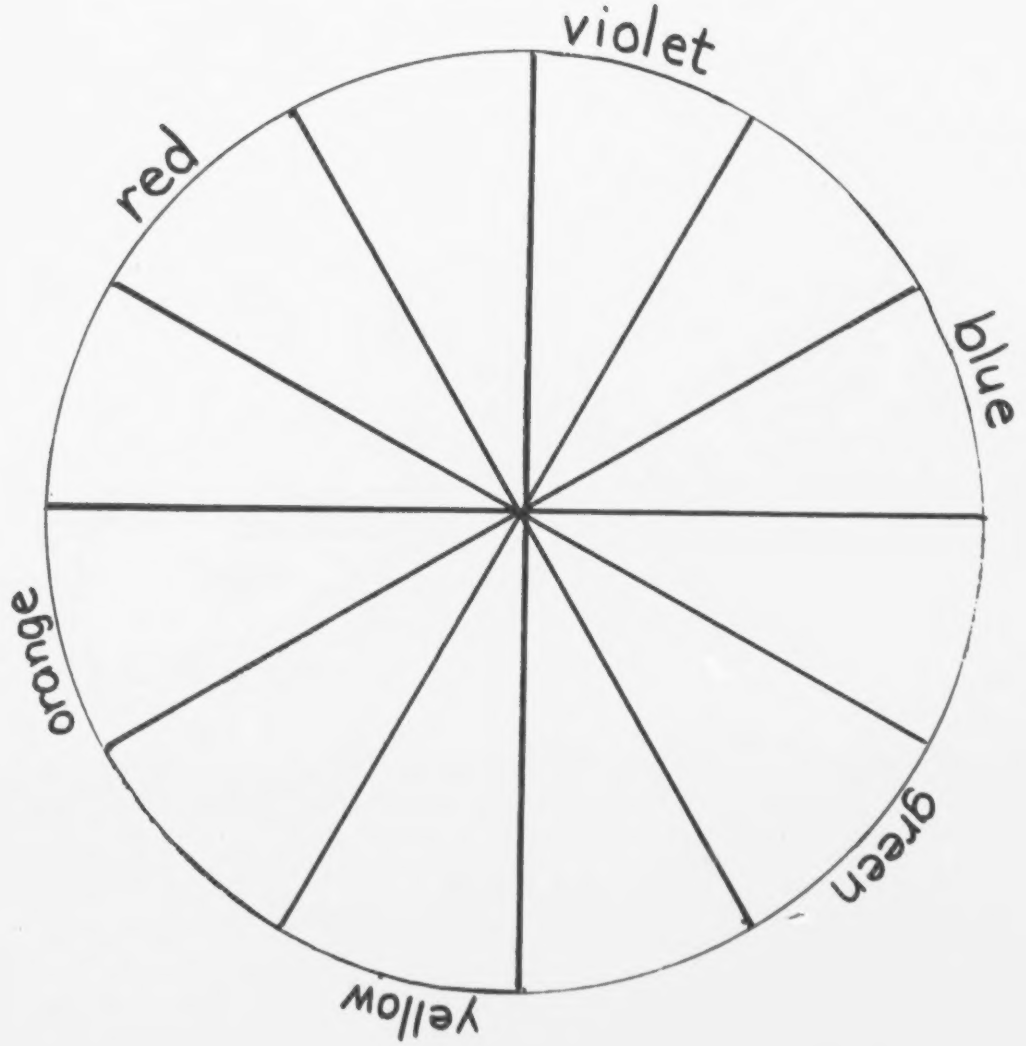
ACTIVITY	MATERIALS/RESOURCES
TASK C: CONTINUED	
2. Have student make a booklet of colors, e.g., one booklet with only red things in it. After finding red pictures for the red booklet, student will understand the concept "red." Next, have student make a blue booklet, then a yellow one.	
3. Have the students share their booklets with each other and discuss the three colors. Tell them that red, blue, and yellow are primary colors. Have them point out other things in the room that are red, yellow, or blue.	Paper, stapler, and magazines for making color booklets; Markers, pens or crayons for labeling the front of the booklet
TASK D: Student will identify secondary colors and make secondary colors from primary colors.	
1. Give student red, yellow, and blue paint. Let the student experiment with the colors for a while, then ask what is happening as the colors are being mixed. Point out other colors forming on the paper. Say, "I told you to use only red, yellow, and blue. Why have you used other paints besides the ones I gave you?" Let student discover that the other colors were made by mixing the three primary colors.	Paper, paints, brushes
2. Given primary colors of paint of transparency paper have student mix to make other colors. Identify colors they have made and what colors they used to get the final color.	
TASK E: Student will read words and match neutral colors.	
1. Give student white, gray, brown, and black paints. Let student paint with them for a time and look at other students' paintings. Ask student how he/she likes the pictures, what is wrong or unusual about them, how the pictures make him/her feel, etc. Tell the student that these are neutral colors. They are not bright and cheerful, but they can be used to make other colors more interesting.	Neutral colors of paint, paper, brushes Large painting
2. Give student one other color--a primary color. Let student mix the primary color with the neutral and see how many different colors he/she can make. Discuss the new colors and how student feels about neutral colors now. Point out how you use neutrals in some places to tone down the bright colors and make the room more peaceful.	Neutral and primary colors of paint, brushes, paper Neutral color word flashcards
3. Display a large painting using many neutrals but also many other colors. Have a discussion about what the painting would look like without the neutral colors or without the other colors.	
4. Have student go through magazines and find advertisements that are only black and white, and advertisements that are black, white, and one other color. Discuss how these advertisements affect how the student feels about the product.	
TASK F: Student will recognize components of the color wheel.	
1. Display a large color wheel. Point to each color and discuss the color and how it was made. Show the position of the primary and secondary colors. Discuss possible ways	Large wall-sized color wheel

ACTIVITY	MATERIALS/RESOURCES
TASK F: CONTINUED	
to obtain the intermediate colors. Allow student to obtain supplies and try to make the colors shown on the color wheel. Give student plenty of time to explore the colors. Tell student the names of the intermediate colors and point out the two colors on each side of them. When the student discovers how to make the intermediate colors, let him/her explain the process. Point out examples of complementary color schemes, analogous color combinations, and monochromatic colors in the school.	
2. Give student the color wheel sheet. Point out the missing intermediate colors. Have student color in the missing colors.	Worksheet F2
3. Give student a blank outline of the color wheel. Let them fill in the proper colors in the appropriately labeled area.	Worksheet F3
4. Give student the vocabulary sheet. Refer to the large color wheel chart to explain each of the terms. Have the student find examples of each term and make a class booklet of pictures with the word at the top and pictures illustrating it under the word.	Worksheet F4
5. Have each student draw a color wheel. Use the posttest worksheet to check student's understanding of the colors and color words.	Worksheet F5

Worksheet F2

WORKSHEET FOR COLOR WHEEL

DIRECTIONS: Mix the appropriate colors and paint in the missing parts of the color wheel. (Remember the missing intermediate colors are made by mixing the primary and secondary color that are on either side of the intermediate color).

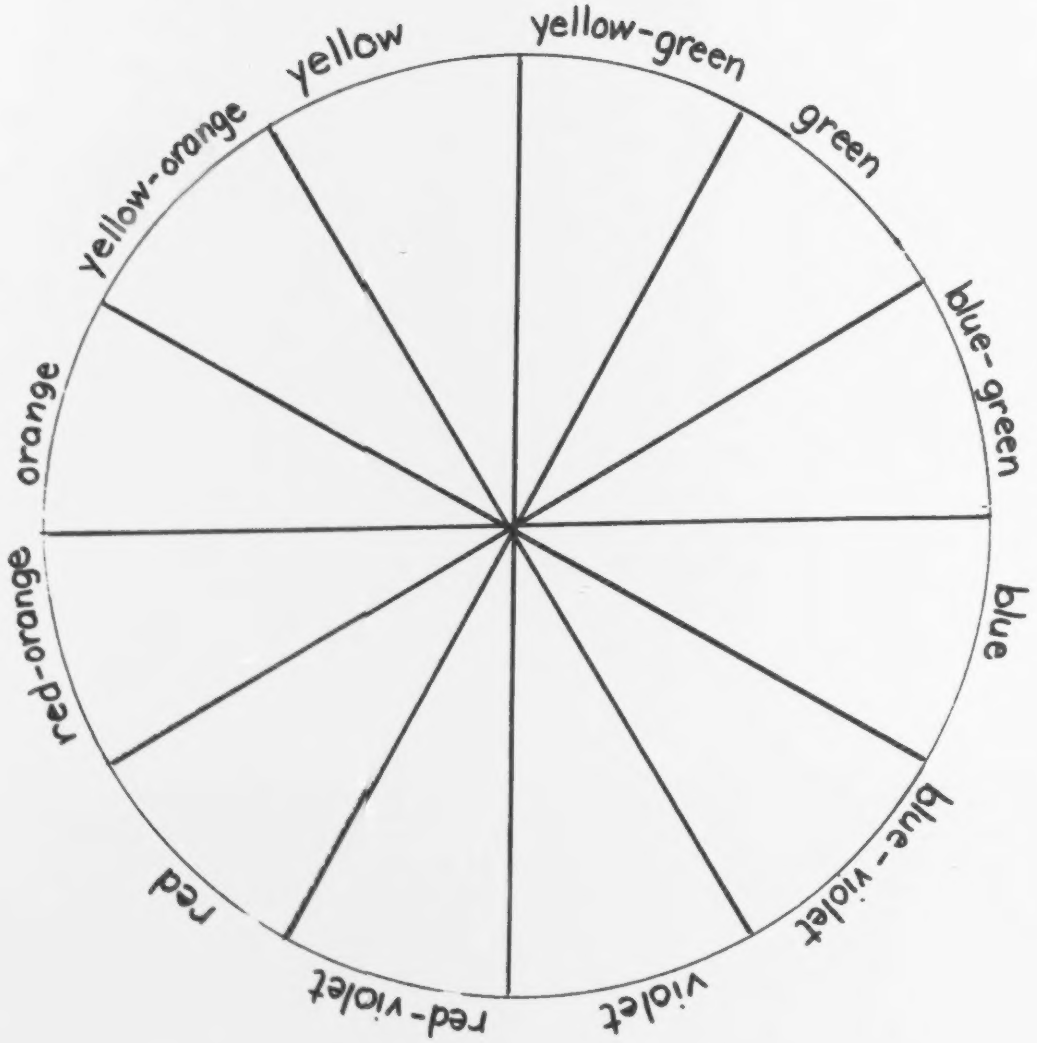

violet
blue
green
yellow
orange
red

277

Worksheet F3

COLOR WHEEL

DIRECTIONS: Paint this color wheel. Use the big color wheel on the wall for a guide, if you need it.


yellow
yellow-green
green
blue-green
blue
blue-violet
violet
red-violet
red
red-orange
orange
yellow-orange

Worksheet F4

VOCABULARY SHEET FOR COLOR

PRIMARY COLORS are red, blue and yellow. All other colors may be made from them.

SECONDARY COLORS are green, orange and violet. They are made by mixing two primary colors.

INTERMEDIATE COLORS are red-violet, red-orange, yellow-orange, yellow-green, blue-green, and blue-violet. They are made by mixing a primary color with a secondary color.

BROWN is a color made by mixing all three primary colors together.

NEUTRAL COLORS are black, white, brown or gray.

BLACK is a color that is considered to be the absence of light.

WHITE is a color that is all light.

GRAY is made by mixing black and white.

COLOR WHEEL is a circle of twelve colors, having the primary colors equally spaced apart on the circle with yellow at the top, secondary colors are spaced between the primaries from which they were mixed with an intermediate color in between the primary and secondary colors.

COMPLEMENTARY COLORS are colors directly opposite each other on the color wheel.

ANALOGOUS COLORS contain at least part of another color such as yellow, yellow-green, green, blue-green, etc.

MONOCHROMATIC means to use the same color, but vary the intensity or value of the color as in a light blue with a dark blue.

GREEN is a secondary color made by mixing yellow and blue.

VIOLET is a secondary color made by mixing red and blue.

ORANGE is a secondary color made by mixing red and yellow.

COLOR begins with light and if there is little light, there is little color. Another word for color is hue. Our sense of color results from the way we perceive the different wave lengths of light that vibrate at different speeds.

Worksheet F5

POSTTEST WORKSHEET

I. Paint in the three primary colors under this line.

____

II. Paint in the three secondary colors by mixing two primary colors under this line.

____

III. Write the names of the primary colors. ______, _______, _______

IV. Write the names of the secondary colors. ______, ______, _______

V. Which colors must I mix to get brown? ____________________

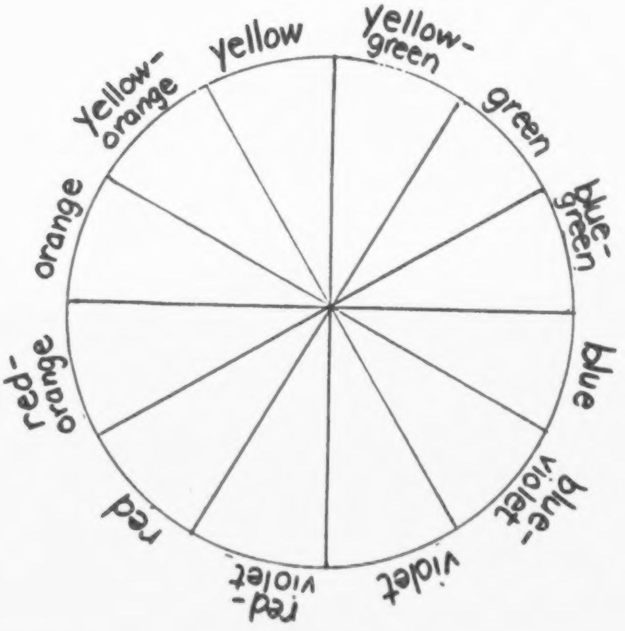
VI. What do we call the colors brown, gray, white and black? ________

VII. Which colors do we mix to get orange? __________ ___________

VIII. Which colors do we mix to get violet? __________ ___________

IX. Which colors do we mix to get green? ___________ ___________

X. Paint in the color wheel below.


yellow
yellow-green
green
blue-green
blue
blue-violet
violet
red-violet
red
red-orange
orange
yellow-orange

Words to use in this posttest: red, blue, yellow, violet, orange, green, primary, secondary, neutral, color wheel, white, black, brown, gray

INSTRUCTIONAL MODULE

ACCESS SKILL: PERFORM BASIC OPERATIONS OF DECIMALS AND PERCENTS ACCURATELY

TASK ANALYSIS STEPS: A-P

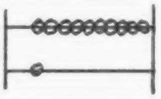
VOCATIONAL AREA:
Autobody
Auto Mechanics
Building Trades
Electronics
Machinist

ACTIVITY	MATERIALS/RESOURCES
TASK A: The student will define the term decimal and give an example of one from his/her daily life	
1. Introduce the unit on decimals by defining a decimal and telling the students that using decimals provides an efficient way of expressing any fractional number or portion of a whole. Follow-up: Contact the parents of the student(s) and let them know that the student is learning about decimals and needs to find ways in which he/she uses decimals in his daily life--such as buying food, clothing, etc. (using money), measuring objects in tenths or hundredths, paying bills, measuring the amount of carpet needed to carpet a room, and so forth. Measurements of pounds and ounces on boxes and cans of food are given in decimal notation and can be compared.	
2. Give students a piece of graph paper and ask them to mark off 10 squares top to bottom and 10 squares side to side. Then they should cut out the squares (100 all together) in one piece. Have them do the same with a second piece of paper and then cut the 10 squares into strips. Have the students line up the 100 square pieces using the smaller strips beside it to show tenths. Show the students how 100 squares = 1 whole and each strip (10 squares) equals .1 (one tenth) of that whole.	Graph paper, scissors
3. Using cuisenairre rods, break the students into groups of 2 or 3 and call out a certain number which the students are supposed to design from their cuisenairre rods. For example: if you say 5.2, the students should get 5 whole rods (10 squares in length) and 2 small squares (one square in length each). Putting these squares in a row makes 5.2.	Cuisenairre rods available from the College of Education Instructional Materials Center, UMC
4. Review what a decimal is and have the students who are still confused look it up in the dictionary.	
5. Use a number line with whole numbers and decimal points to point out the whole numbers vs. the decimal units.	
TASK B: The student will successfully explain the concept of decimal notation through tenths	
1. Give students a chance to be teacher for the day and have them teach someone else how to read numbers with decimals notations up to tenths. Write some numbers on the board and assign the students in pairs to teach the steps you use when reading decimal notation.	

ACTIVITY	MATERIALS/RESOURCES

TASK B: CONTINUED

2. Use an abscissa to demonstrate tenths. Push ten markers on the abscissa over to one side of the line. Then explain to the students that that is one line. Next push 1 marker at a time over to the line beneath the full line and ask the students to explain or call out the tenths that are made. For example:



Then ask the students to write that number as a decimal.

TASK C: The student will accurately read and write decimals through hundredths

1. Write some numbers on the board using decimal notation. For example: 5.7, 8.9, 10.3, etc. Ask the students to raise their hand when they can call out the correct number written --stating it as a decimal notation.

2. Ask the students to go to the board and see who can write the decimal quickest. Call out the following decimals and others and see who can write them as you say them. For example: Call out, "seven and nine tenths." The student should write 7.9, etc.

3. Make some bingo sheets with various decimals written on them. (You might want to laminate the sheets so higher numbers can be used for the same game later on.) Put strips of paper with the same numbers on them as appear on the Bingo game in a box. One at a time pull out a number and call it out. See which student can get Bingo first. Let students be the leader or caller of the numbers from time to time so you can test their ability to read the numbers correctly.

4. Using 5 pieces of paper or tagboard, write numbers on each and mix them up to get a different number each time. You will place the pieces of paper on the chalkboard (using tape) with a decimal point somewhere on the board to show tenths or hundredths. For example:

   5|4|6 . 8|2 or 8|6|4 . 5|2

   Point out to the students that it does not matter which number is in which place, the numbers to the right will be tenths and hundredths.

TASK D: The student will accurately read and write decimals through thousandths

1. Draw a number line on the board and mark the columns to the right of the decimal place as tenths, hundredths, and thousandths. Then review the tenths and hundredths columns from previous lessons. Introduce the thousandths column and talk about how that column is used and by whom (machinists, baseball players, technicians, lab workers, pipe fitters, etc.). Call out some numbers and ask which column they should be placed in. For example: Call out "one hundred forty-three and 324 thousandths". Write the numbers under the columns discussed above to demonstrate the columns of decimals.

ACTIVITY	MATERIALS/RESOURCES

2. Give the students worksheets with various numbers on them--using decimal notation to the thousandths. Ask the students to accurately read the numbers given.

3. Call out numbers with decimal notation to the thousandths and tell the students to write the numbers as they hear them. Check to make sure the student can accurately write 8 out of 10 numbers correctly.

TASK E: The student will identify the greater or lesser of two decimals using the sign for greater than or less than

1. Discuss with students why it might be necessary to compare decimals. (To find the greater or lesser of the two). If a carpenter has to drill a hole, he wants to make sure it is the right size and may need to compare drill bits. He might compare .8880 to .555. Which would be the larger drill size? (.8880)

2. Demonstrate to the students by comparing two numbers in tenths, then hundredths, and then thousandths to clearly determine why one number is larger than the other.

   For example: 4.3 < 4.9 because nine is more than three
   4.37 > 4.32 because seven is greater than two
   7.810 > 7.803 because the number closest to the numbers that differ are the 10 and the 03 and .10 is more than .03. The eights cannot be compared because they are obviously the same number.

3. Give the students worksheets with various numbers on them and ask the students to put the less than (<) and greater than (>) signs on them after accurately comparing the two numbers.

TASK F: The student will accurately solve addition problems involving decimals through thousandths

ACTIVITY	MATERIALS/RESOURCES
1. Write various numbers on the board which include the use of decimals. Add the two numbers as a demonstration.	Chalkboard, chalk

   For example:

$$\begin{array}{r} 0.7 \\ \underline{+1.2} \\ 1.9 \end{array}$$

   Once the students have done problems adding with decimals in a vertical manner, give them demonstration problems on the board in a horizontal manner.

   For example: 1.4 + 3.9 = 5.3

2. Give the students worksheets with the above type problems on them. Students should be able to do 8 out of 10 or 16 out of 20 problems accurately without assistance before moving on.

3. Demonstrate working addition problems using decimals to the hundredths in the same manner as above.

4. Demonstrate on the board or overhead projector adding decimals to the thousandths--using more than two numbers.

ACTIVITY | MATERIALS/RESOURCES

TASK F: CONTINUED

For example:

$$\begin{array}{r} 54.48 \\ 18.4 \\ 25.38 \\ 19.02 \\ +\ 6.43 \\ \hline 123.71 \end{array}$$

Also give problems such as:

19.2 + 6.43 + 20.01 = ________

TASK G: The student will accurately solve subtraction problems involving decimals through thousandths

1. Provide the students with a demonstration of regular subtraction problems before beginning this portion of the lesson. Be sure in your discussions that everyone can subtract accurately.

2. Demonstrate subtraction of problems using decimals. Give the first few problems in which no borrowing is necessary such as:

$$\begin{array}{r} 0.86 \\ -0.23 \\ \hline .63 \end{array} \qquad \text{and } 0.94 - 0.43 = \underline{0.51}$$

Give the students worksheets, have them figure problems at the board, let them figure problems on large pieces of tagboard. Be sure the students can do 8 out of 10 problems before going on to subtracting more difficult problems (such as borrowing).

3. Introduce borrowing to the students just as they did when subtracting whole numbers. Make sure they understand that you begin subtracting from the right side and borrow from the number just to the left of that number. For example:

$$\begin{array}{r} 31 \\ 2.\cancel{4}\cancel{3}7 \\ -0.196 \\ \hline 1.241 \end{array}$$

Review borrowing orally before assigning any individual work.

4. Give students vocational problems which require subtraction of decimal numbers. For example:

If the standard measurement of a cylinder is 3.625, and the cylinder you are measuring is 0.0122 over the standard, what is the difference?

3.625 - 0.0122 = ________

Follow-up: Ask the students to work with their parents at home to identify the differences in weight of two boxes of cereal, 2 cans of beans, 2 boxes of crackers, 2 cans of soup, 2 bars of soap, etc. The students should do this activity on their own or with parent assistance.

5. Give the students magic square problems to reinforce and use as a self-checking problem. The students complete something like Worksheet G5 when doing a magic square problem. — Worksheet G5

ACTIVITY | MATERIALS/RESOURCES

TASK H: The student will solve addition and subtraction problems involving money

1. Discuss with the students why it is important to be able to subtract money accurately. (Some answers might be: so you don't get cheated at the store, so you can do your job if it requires making change, so you can fill out an order form accurately, etc.)

2. Give students a menu from a local restaurant and ask them to pick out 6 items they would order if they could go out to dinner. Have them circle those items. Then ask them to find the differences in price of all six.

Menu from local restaurant

3. Point out to the students that each penny is one hundredth of a dollar, and that is written $0.01.

   Follow-up: Ask the parents to become actively involved in the student's knowledge of money and the differences when subtracting by bringing out their last two electric bills and helping the student find the difference. (They might even want to discuss the reasons for the differences.)

4. Give the students worksheets in which they must add and subtract with money. For example:

$$\begin{array}{r}\$3.75\\ \underline{-0.68}\end{array} \quad \text{and} \quad \begin{array}{r}\$6.98\\ \underline{+3.27}\end{array}$$

5. Ask the students to find the total points earned by a figure skater, olympic runner, etc. Then to find the score of another person in the same event and finally to find the difference.

6. Time students in the 1 mile run two different times. Have the students write down their time on each run and then figure the difference.

TASK I: The student will accurately solve problems in multiplying decimals

1. Discuss the proper method of multiplying whole numbers and point out that multiplying decimals is done the same way. Demonstrate where the decimal point goes in multiplying (the number of numbers appearing to the right of the decimal point in both the multiplier and the multiplicand tells you the number of numbers which will be to the right of the decimal point in the answer).

   For example: $\begin{array}{r}3.678\\ \underline{\times\ .9}\end{array}$ has 4 numbers to the right of the decimal point

2. Give the students problems to figure such as:

   Find the perimeter of a baseball field when each side is

   26.50 ft. (26.50 x 4 = ________)

   If a gallon of gasoline costs $1.16 and you bought 4.5 gallons, how much would the gasoline cost? $\begin{array}{r}\$1.16\\ \underline{\times\ 4.5}\end{array}$

ACTIVITY	MATERIALS/RESOURCES

TASK I: CONTINUED

Follow-up: Ask parents to work with the student in figuring how much their light bill would be if each kwh = $0.67 and they had their lights on for 5.2 hours each night. Ask parents to figure their bills to the detail and encourage the student to work with them to be able to figure their own bills.

TASK J: The student will accurately solve division of decimals

1. Review division and the process to use. Then point out to the students that division using decimal notation is no different as far as the numbers are concerned, but the decimal must be moved to the far right of the divisor and then as far right on the dividend as you moved it on the divisor.

   For example: $2.36\overline{)4.821}$ Move the decimal point two places to the right in both the dividend and the divisor, so that the divisor is a whole number. Place the decimal point in the answer in the same position that it appears after moving it in the dividend.

   Work a few example problems on the board for explanation.

2. Give the students worksheets involving division of numbers with decimal notation and make sure they can do 80% accurately without assistance before moving on.

3. Give students word problems involving decimal notation. For example: If you have 12 sheets of metal that are 48.12 inches wide all together, what is the width of each?

TASK K: The student will accurately solve equations involving decimals

1. Review all of the problems and ways to solve problems of numbers with decimal notations (addition, subtraction, multiplication, and division) and make sure the students can complete these types of problems with 80% accuracy before going on.

2. Give the students worksheets such as the following:

4.32	+		=	8.18
-	▨	-	▨	-
2.49	+	3.07	=	
=	▨	=	▨	=
	+	.79	=	

   and so on with multiplication and division problems.

TASK L: The student will accurately estimate the value of a decimal

1. Discuss with the students the methods of estimation and how you estimate a number (round it off). For example: .678 is estimated to be .7 because it is closer to .7 than to .6 due to the numbers 7 and 8 being higher than 5. Show students several examples before asking them to perform this task.

ACTIVITY	MATERIALS/RESOURCES

TASK L: CONTINUED

2. Give the students several problems involving estimating using decimals such as the problem above. Then ask the students to perform the basic operations and estimate the answers.

For example:

$$\begin{array}{r} 2.33 \\ \underline{+1.69} \\ 4 \end{array} \quad \text{(the answer is estimated to be 4)}$$

$$\begin{array}{r} 2.39 \\ \underline{\times\ .42} \\ 2 \end{array}$$

(the answer is estimated to be 2 because .42 is less than 1 and 2.39 is closer to 2 than to 3)

TASK M: The student will accurately convert decimals to fractions and vice versa

1. Explain to the students that a decimal and a fraction are simply two different ways to show or express a portion of something. They equal each other when figured accurately. For example:

$$3/4 = 4\,\overline{)\,3.00}^{\;.75}$$

If you have a decimal and want to express your answer as a fraction, you simply divide your decimal by 100 or 1000--whether your number is expressed as hundredths or thousandths.

For example: $\frac{75}{100} = \frac{3}{4}$

2. Work some sample problems on the board and then assign various problems for the students to do on their own.

TASK N: The student will accurately write decimals as percents

1. Explain to the students that two place decimals can be written as percents and percents as decimals. Give the students a few examples. For instance:

$$.66 = \frac{66}{100} = 66\%$$

Put some numbers on the board and let students decide what the percentage, the decimals, and the fractions would be written for various numbers.

2. Give students problems in which the decimal number is given and they must write it as a percentage. For example:

.43 = ____%　　.09 = ____%

3. Give students problems in which the decimal number is given and the students must convert them to decimals. For example:

22% = 0.____　　6.5% = 0.0____

4. Give the students problems in which the decimal and percentage are given and the student must convert it to fractions.

ACTIVITY	MATERIALS/RESOURCES
TASK O: The student will accurately round off decimals	
1. Discuss with the students how to round off whole numbers to the nearest number 1, 10, 20, etc. For example: Is 4 closer to 1 or 10? 1 , so we round it off to 1. Then talk about rounding off numbers when they have a decimal notation. For example: Is 2.68 closer to 2 or 3? (3)	
2. Do several problems on the board until it appears that everyone has a clear grasp of the idea. Then assign work either from the board or on paper.	
TASK P: The student will accurately solve word problems involving decimals	
1. Discuss with the students the various types of problems which might require the use of adding, subtracting, multiplying, and dividing decimals. Give an example of a discount problem--in order to see how much you pay for an item on sale. For example: A construction worker's necessary tools usually cost approximately $375.50, but they are on sale for 25% off (or .25). How would you find the cost of the tools? How much would the tools cost? You may want to ask "How would you find the number needed" until you are sure the student has the method of solving the problem clear in his/her head.	
2. Using a newspaper, solve the saving on groceries, clothes and other items--using decimals to figure them.	Newspapers

Worksheet G5

6.2	-	4.1	=	
-	☒	-	☒	-
5.3	-		+	1.4
=	☒	=	☒	=
	-	0.2	=	0.7

8.180	-		=	4.320
-	☒	-	☒	-
5.560	-		=	
=	☒	=	☒	=
	-	0.79	=	

Bibliography

Cuisenairre Rods: College of Education, Instructional Materials Center, University of Missouri-Columbia.

Duncan, Ernest, W.G. Quast, William Cole, MaryAnn Hater Haubner, and Thelma Sparks. Mathematics. Houghton-Mifflin, Co. Boston, Massachusetts, 1981.

Eicholz, Robert, Phares O'Daffer, and Charles Fleener. Mathematics in Our World (second edition), Addison-Wesley Publishing Company, Menlo Park, California, 1981.

Geier, Alvin and Nathaniel Lamm. Mathematics and Your Career. AMSCO School Publications, Inc., New York, New York, 1978.

Moore, George. Practical Problems in Mathematics for Automotive Technicians. Delmar Publisher, Albany, New York, 1979.

Shaw, Bryace, Grayson Wheatley, Robert Kane, and Miriam Schaefer. General Math 1. Houghton-Mifflin, Co., Boston, Massachusetts, 1977.

Duplicating Masters

Math Enrichment Duplicating Masters, Milton-Bradley, 1976. (available from the L.D. classroom at Hickman High School.)

INSTRUCTIONAL MODULE

VOCATIONAL AREA:

Machinist
Carpentry
Air Conditioning and Refrigeration
Auto Mechanics
Welding
Auto Body

ACCESS SKILL: PERFORM BASIC OPERATIONS USING FRACTIONS

TASK ANALYSIS STEPS: A-U

ACTIVITY	MATERIALS/RESOURCES
NOTICE FOR MODULE INSTRUCTION This module is intended to be used in conjunction with one or more math books. Several references and resources are listed in the bibliography which provide additional practice pages. It is not the intent of this module to provide practice pages, but to provide activities which help teach fractions as well as vocational application prototype problems which will give students a better understanding of the general trade and industry areas.	
PRETEST INSTRUCTION The three-part pretest is located at the end of the task analysis and instructional activity portion. The pretest may be used for both pre and post testing. It may be given at one sitting, or broken down into sections. Part 1 is theory and expressing fractions in simplest terms. Part 2 is actual problems. Part 3 is application problems.	Pretest Part 1 Part 2 Part 3 Answer Sheet
TASK A: Student will define the term "fraction", and give an example of one from his/her daily life	
1. Discuss with the student how we use the term fraction in daily conversation. For example: "He won the race by a fraction of a second. The door she cut was a fraction of an inch too short." In math we define a fraction as a PART OF A UNIT. Follow-up: Fractions are used often in daily living situations. Talk to your student about what 1/3 cup means when you're making a cake; about 1/2 of a can of oil when you're changing the oil in the car; 1/4 inch when you are measuring something.	Graph paper, pencil
2. ACTIVITY: Group students in pairs. Have them cut 4 pieces of graph paper 12 x 12. a. Cut one region into 2 parts. Are they the same size? Label each 1/2. b. Cut one region into 3 equal parts. Label each 1/3. c. Cut one region into 4 equal parts. Label each 1/4. d. Cut one region into 6 equal parts. Label each 1/6. e. Ask questions such as "Which is smaller 1/2 or 1/4?" "1/3 or 1/6?" "Which is the largest?" "Which is the smallest?"	Graph paper, See also Modern Curriculum Press for dittoes on fractions
3. ALTERNATIVE: Use the same procedure with circular regions or shading diagrams.	
4. Use a number line to show relative sizes. Ask the same kinds of questions.	

ACTIVITY

MATERIALS/RESOURCES

TASK B: Student will define in his/her own words numerator and denominator and identify same in 3 out of 4 examples

1. DISCUSSION: A pie has been divided into 4 equal parts and you have eaten 3 pieces. You have eaten 3/4 of the pie. (Show in a diagram or with a flannel-board).

2. In any fraction, the denominator tells how many parts are represented. The numerator tells into how many parts the original was divided.

3. Using the graph paper cutouts from Task A, have the students divide into pairs and have each student hold up the 1/2 and tell his/her partner what the 1 and the 2 in 1/2 mean. Have them do the same for 1/3 and 1/6.

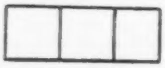
4. Give the students a sheet with the following and similar problems:

Shade the following:

a. You cut 1/2 of this board.
What is the numerator?____

b. You used 1/6 of this pipe.
What is the denominator?____

c. You need 1/8 of a piece of copper tubing.



d. The wall will be 1/3 blue.
What are the denominators?____ ____

Follow-up: Examples such as these abound in the home and help the student understand the usefulness of fractions. Have student help cut and measure boards, pipes, tubing or cook with a recipe.

5. Have students work problems on the practice sheet. Some they can do alone, some together, and some as a class.

Worksheet B5

TASK C: Student will be able to express a set of items in fractional terms

1. Use concrete examples to get students to think in fractional terms, such as: There are 6 people in our class. 3 are boys. What fraction of our class are boys? (3/6) There are 6 people in our class. 5 have black hair. What fraction of our class has black hair? (5/6)

Follow-up: In class try to get the student to respond to common questions by using fractional terms. Ask parents to do the same if they wish. For example: I mowed ____ of the grass (instead of part of it). I did ____ of the dishes (instead of some of them). I took out ____ of the garbage. I have ____ left to take out.

2. Vocational examples: (May be done orally or written)

6 tools in all
2 are pliers
___of the tools are pliers

9 tools in all
3 are wrenches
___of the tools are wrenches

4 6-penny nails
25 nails in all
___of the nails are 6-penny nails

4 trucks
100 vehicles
___of the vehicles are trucks

ACTIVITY

MATERIALS/RESOURCES

TASK C: CONTINUED

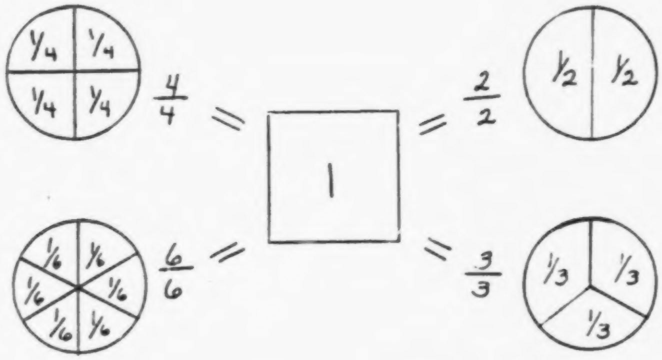
17 questions right
20 questions
___of the questions are right

3 questions wrong
20 questions right
___of the questions are wrong

TASK D: Student will generate fractions equal to one whole

1. DISCUSSION: Elicit from the student what constitutes a whole. Discuss whole pies (before a piece is missing), whole boards (before an end has been cut off), whole cans of oil (before some has been poured out). Have the students generate that something is whole before a portion has been removed.

   Put the diagram on the board, flannel-board or overhead. Use it to help students understand that when the same number is in the numerator and denominator, the fraction is equal to one whole. Have the students add to the diagram.



2. Construct varying kinds of problems to give students practice using fractions:

   A carpenter needs to find which of these fractions are equal to 1: 100/100, 15/20, 7/8, 18/18, 53/53

   An electrician wants to find out which of these fractions are equal to 4/4: 4/5, 8/8, 11/11, 1/3

   An auto mechanic needs to find out which fractions are equal to 15/15: 1/1, 1/6, 8/5, 3/4

ACTIVITY

MATERIALS/RESOURCES

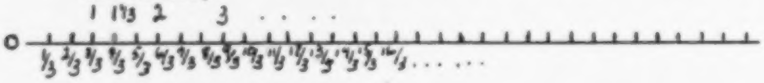
TASK E: Student will identify fractions greater than 1 (mixed numbers)

1. Introduce mixed numbers with examples that students are familiar with. For example: If you have 5 quarters to go downtown, how much do you have in dollars? (1 dollar, 1 quarter = 1 25/100) If you have 12 dimes and want to play video games that cost a dollar, do you have enough?

   Encourage students to discover a mixed number is a whole number and a fraction.

   Follow-up: The most common places to see mixed numbers are in the kitchen and garage. Doubling or reducing recipes, using different measuring cups than those that are called for will give students practice using mixed numbers.

2. Use the number line to show mixed numbers. (Students brainstorm).



   Have students make groups of 2 or 3. Have each make a number line using a different unit. (1/3, 1/4, 1/8, 1/16) Have them compare number lines. Which has the most units between whole numbers? Which has the least? Have them use the number lines to solve the vocational problems.

   An electrician needs to cut a wire 1 5/8". But his ruler is calibrated in 16ths of an inch. How many 16ths would it be? _____ (2 steps--do it together)

   A carpenter is cutting a joist that is 3 5/8" thick. How many 16ths inch are in 5/8"? ________________

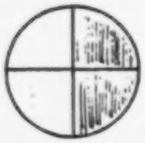
   A car mechanic is using a bolt 1" in diameter. How many 1/4 inches is it? ________________

TASK F: Student will generate equivalent fractions

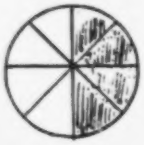
1. Have a student pick a fraction (such as 1/3). Have other students multiply the numerator and denominator by various numbers. Draw out the new fraction and lead the students to understand that the value of the fraction has not changed, just the name.

   For example: 1/2

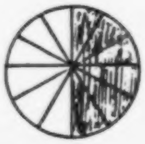
Pick 2
2/4



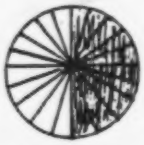
Pick 4
4/8



Pick 6
6/12



Pick 10
10/20



2. Using the same procedure, have the students find 6 fractions equal to 2/3, five fractions equal to 1/4, etc.

ACTIVITY | MATERIALS/RESOURCES

TASK F: CONTINUED

3. DISCUSS: Equivalent fractions are different names for the same quantities. You can multiply both terms of a fraction by the same number and not change the value.

   Follow-up: Measuring with a ruler offers lots of practice making equivalent fractions. For example:
   1/2" = ______1/4"

4. Have students work in twos and cut out the 8 x 1 cardboard model (Worksheet D1). By working together they need to complete these sentences:

   Worksheet D1

   1/2 = ___/4　　1/4 = ___/8　　1 = ___/4

   1 = ___/8　　1/2 = ___/8　　1 = ___/2

5. Give students vocational problems such as:

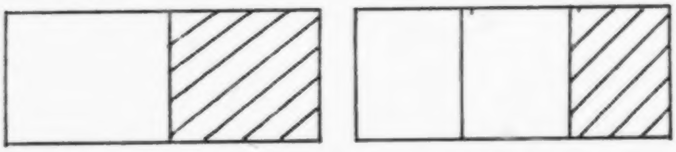
   A carpenter wanted to cut 3/8" off a board. How many 16ths inch would that be?

   How many 1/16 inch are there in a 5/8" diameter bolt?

TASK G: Student will compare fractions using > (greater than), < (less than), and = (equal to)

1. INTRODUCE: Use rectangles of equal size. Ask students to shade 1/2 in one and 1/3 in the other. Discuss which is the largest. Do the same comparing 1/4 to 1/3, 2/3 to 3/4, 1/3 to 5/6, and 2/3 to 1/2.

   For example:



2. REVIEW the concepts of greater than, less than and equal. REMIND students that the arrow always points to the smaller number. Do more shading problems similar to those in activity 1, but use the signs <, >, and =.

   For example: 1/2 > 1/3,　1/3 < 1/2

3. Have students use the units that they cut on Task A. Have them generate their own inequality problems, trade with a friend and work them. They then must check their friend.

   Follow-up: Continue to involve students in activities which emphasize fractions. Activities which emphasize use of different size wrenches or screwdrivers are good to show students that some tasks need varying sizes. For example: Socket wrenches are calibrated in varying sizes, as are bits for drills. Have students _see_ the sizes of the drills or bits as they _say_ the different sizes. 5/8" bit is less than 1/2" bit, etc

ACTIVITY | MATERIALS/RESOURCES

TASK G: CONTINUED

4. Give students vocational problems similar to these:

   a. Which socket is larger, 1/2 or 5/16? (use number lines, or pictures) (1/2)
   b. Which nut is smaller, 5/8 or 1/2? (1/2)
   c. Which hose is larger, 2 3/8 or 2 5/16? (2 3/8)
   d. Which garden is larger, the one that is 5 by 7 1/4 feet or the one that is 5 by 7 1/3 feet? (5' x 7 1/3')
   e. Which cup holds less, the 3/4 cup or the 1/2 cup? (1/2 cup)
   f. Which of the following wires is smaller than 1/2"?
      1/4"   2/3"   1/5"   2/2"

TASK H: Student will use the terms prime number and composite number correctly when working factor trees

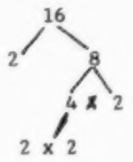
NOTE
For most students this should be a review. They should have had experience with factoring earlier. If they haven't, the teacher will need to do more reinforcement and instruction.

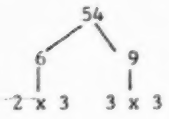
1. REVIEW: Prime number--can't be divided by any number except one and itself to yield a whole number.

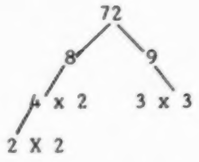
   Composite number-may be divided by a number other than itself and one.

   For example: 22 = 11 x 2 (these are prime numbers)
   18 = 6 x 3 (6 can be divided by 3 and 2--it is composite)
   (3 can only be divided by itself--it is prime)

   Give some examples of factor trees. (Student is to supply handwritten answers.)







   (Putting in X sign helps.)

2. Give students lots of board examples and seat examples on finding the common factor. For example: Name the common factor for these: | Worksheet H2

   4/12 _____   6/9 _____   5/15 _____
   3/6 _____   6/54_____   7/21 _____

   This is the most difficult aspect for many students to understand. It needs lots of time and reinforcement. (See drill page)

ACTIVITY	MATERIALS/RESOURCES

TASK I: Student will express fractions in their simplest form

1. To introduce the simplest form of a fraction, have students make chains as they did in task F. Brainstorm which is the simplest form (use lowest terms if necessary). For example:

1/2	2/4	4/8	8/16	16/32
2/5	6//15	8/20	10/25	12/30

2. Tell students just as they could multiply a fraction and not change the value, they can divide each term by the same number and not change the value.

For example: $\frac{4 \div 4}{8 \div 4} = \frac{1}{2}$ or $\frac{3 \div 3}{18 \div 3} = \frac{1}{6}$

3. Set up charts as the following to help students express fractions in simplest form:

FRACTION	8/12	5/15	8/32
Factors in numerator	1,2,4,8		
Factors in denominator (Circle common factors)	1,12,3,4 6,2		
Greatest common factor	4		
Divide by	4		
Simplest form	8 - 4 = 2 12 - 4 = 3		

4. Do vocational application problems such as the ones on Worksheet I4.

Worksheet I4

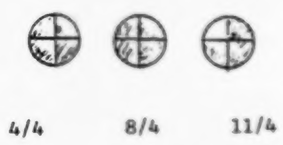
TASK J: Student will express improper fractions as mixed numbers

1. REVIEW division showing remainders as fractions. For example:

$$\begin{array}{r} 6 \\ 13\overline{)84} \\ \underline{78} \\ 6 \end{array} = 6\ 6/13$$

2. Use diagrams, or a number line (made in Task E) to show students the relationship between improper fractions and mixed numbers. For example:

11/4 =



= 2 wholes and 3/4

Have the students draw out and shade in:

13/5 21/6 17/7

ACTIVITY	MATERIALS/RESOURCES

TASK J: CONTINUED

3. INSTRUCTION: When we want to rename fractions greater than a whole number, we just divide the numerator by the denominator. For example:

$$11/4 = \begin{array}{r} 2\ 3/4 \\ 4\overline{)\ 11} \end{array}$$

$$13/5 = \begin{array}{r} 2\ 3/5 \\ 5\overline{)\ 13} \end{array}$$

NOTE: Some students have trouble knowing when to divide. They may need more practice on identifying improper fractions. They may grasp the idea better if you talk in terms of the fraction being TOP HEAVY -- that is the top number (numerator) is larger than the bottom (denominator). They may need further practice in locating and identifying improper fractions.

Follow-up: A concrete way to understand improper fractions is through using measuring cups. If a recipe calls for 2 1/2 cups flour, have the student measure all the flour with the half-cup. This will allow him/her to discover that 2 1/2 does equal 5/2. The same procedure can be done with varying sizes. The same kind of activity can be done measuring. Have a student measure a surface using just 1/2 inches and see if he can get the same answer after simplifying as he got with whole inches.

4. Give the student vocational practice problems such as:

   a. A cook put in 11 quarter cups of flour. How many whole cups and what fractional part did she put it?______(2 3/4)
   b. A brace that a builder uses measures 7 inches. What part of a foot is that? ____(7/12). What part of a yard is that? (Hint: A yard is 36 inches.) _____(7/36)
   c. A painter worked 7 half hours painting a house. How many whole and half hours did he work? ____(3 1/2)
   d. An electrician needed a wire that was 67/4 inches long. How long was the wire?_____(16 3/4)
   e. Jerry is making some shelves. Each shelf is to be (13/2) feet long. How long is each shelf in whole feet?____ (6 1/2)
   f. A mechanic worked 18/4 hours on a manifold. How many whole hours did he work?____(4) What fractional hour did he work?_____(1/2)

TASK K: Student will successfully multiply fractions

1. INTRODUCE multiplying fractions to students by using the following examples:

   If I have 3 quarters, what part of a dollar do I have?
   3/1 x 1/4 = 3/4
   If I have worked 4 half-hour periods, how long have I worked?
   4/1 x 1/2 = 4/2 = 2 hours
   If I have 1/5 of a 5/8 ft. board, how much do I have?
   1/5 x 5/8 = 5/40

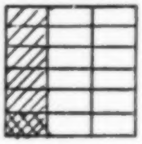
   In each case have students tell you why you multiply (that it is the same as successive addition).

ACTIVITY | MATERIALS/RESOURCES

TASK K: CONTINUED

2. To help students understand that multiplying fractions may give you a smaller amount, have them draw out some examples.

For example:
1/3 x 1/6
Make 1/3 ////
Make 1/6 \\\\ on the other axis



Draw out 1/2 x 1/3
2/5 x 1/4
1/6 x 2/3

3. You may need to use flannelboard cutouts or pie graphs to go over this with some students who have difficulty.

4. Vocational problems can be developed such as these:

(Be sure and simplify your answers.)

a. Mr. Jones is a chef. He had 3/4 dozen eggs and he used 1/2 of them. How many did he use?____ (3/8)

b. Ms. Smith is an electrician. She had 1/2 ft of copper wire and used 5/8 of it. How much did she use?____ (5/16)

c. Mr. Maniford is an auto repairman. He had 3/4 foot of tubing and used 1/3 of it repairing a hose. How much did he use?____ (3/12 = 1/4)

d. If Mrs. Bransford used 1/2 of the 7/8 foot board for a rod, how much was used?____ (7/16)

e. A painter had 1/2 of a can of blue paint. He used 1/3 of it painting a cupboard. How much was used?____(1/6)

5. After many pages of practice with multiplying, CANCELLING may be introduced. (A term that will cause less confusion is dividing before we mutliply).

INSTRUCT the student that we divide before we multiply by the common factor (covered in Task H).

For example: 2/4 x 6/8 = $\frac{\overset{1}{\cancel{2}}}{\underset{2}{\cancel{4}}} \times \frac{\overset{3}{\cancel{6}}}{\underset{4}{\cancel{8}}}$ May help to use colored pencils or colored chalk to show students that we work with numbers diagonally across. Also it might be advisable to let students do the cancellation problems on graph paper, so that each number can be lined up diagonally.

TASK L: Student will successfully multiply mixed numbers

1. INTRODUCE: Have students practice changing mixed numbers into improper fractions. (This is the reverse of what they did in Task I).

For example: 3 1/2 = (Think 3 x 2 + 1 = $\frac{7}{2}$)

ACTIVITY	MATERIALS/RESOURCES

TASK L: CONTINUED

It may help to draw arrows in colored pencil to help students see and remember that they are to multiply.

For example: $\overset{\curvearrowright^{\times}}{3 \times \frac{1}{2}} = \frac{7}{2}$ or $\overset{\curvearrowright}{3 \times \frac{1}{2}}^{+1} =$

Follow-up: Suggest to parents that student could do the following at home or have student do in class:

Have the student figure area of rooms in the house. (These usually include fractions.)

Have the student take an active part in constructing something that involves measuring, or plotting out a garden.

Have the student increase or decrease a recipe that involves mixed numbers.

Have the student calculate his/her own allowance, based on a set rate per hour.

Have the student double-check bills that involve fractions, such as light bill.

2. After students are comfortable changing a mixed number to an improper fraction, tell them that to multiply mixed numbers, we first change them into improper fractions and then multiply.

For example: $3\ 1/2 \times 4\ 1/4 = \frac{7}{2} \times \frac{17}{4} = \frac{119}{8} = 14\frac{7}{8}$

3. Give the students many experiences multiplying mixed numbers, including vocational problems like these:

A carpenter was to figure these areas. Help him multiply.

Shelf 2 1/2 feet by 7 3/4 feet = 19 3/8

5/2 x 31/4 = 155/8

Window 3 1/3 feet by 2 1/2 feet = 8 1/3

$\overset{5}{\cancel{10}}/3 \times 5/\underset{1}{\cancel{2}} = 25/3$

Tile 11 1/2 inch by 8 1/4 inch = 94 7/8

23/2 x 33/4 = 759/8

Cabinet 15 1/4 feet by 3 1/5 feet = 323 3/10

61/4 x 16/5 = 6466/20

4. REVIEW expressing a whole number as a fraction, by using 1 as the denominator.

For example: 6 = 6/1, 100 = 100/1, 5000 = 5000/1

5. Go over multiplying mixed numbers with the student. Whole numbers are the same.

ACTIVITY | MATERIALS/RESOURCES

TASK M: Student will successfully divide fractions

1. Have the students multiply the following:

   4/5 x 5/4 =
   1/3 x 1/6 =
   1/7 x 7/1 =
   2/3 x 3/2 =
   4/9 x 9/4 =
   8/7 x 7/8 =

   Have the students circle all those answers that are equal to one. Ask them "What do you notice about the terms of the fractions that are equal to 1?" (They should say, when multiplied they are turned upside down.) Say "Yes, two fractions that equal 1 are called reciprocals."

2. Give the students practice problems fading out information.

   For example: 2/3 - 4/7 = 2/3 x 7/____ =
   5/4 - 2/6 = 5/____x 6/2 =

TASK N: Student will successfully divide mixed numbers

1. REVEIW process of multiplying mixed numbers (See Task L).

2. Use division process, but rename mixed numbers as fractions first.

   For example: A carpenter needs 2 1/2' lengths of board. How many will she get from a board 6 1/3 long?

   6 1/3 - 2 1/2 = $\frac{19}{3} - \frac{5}{2}$ (Change to improper fraction)

   = $\frac{19}{3}$ x (Change sign)

   = $\frac{19}{3} \times \frac{2}{5}$ (Reciprocal)

   = $\frac{19}{3} \times \frac{2}{5}$ = (Multiply)

   = $\frac{38}{15}$ (Simplify)

   = 2 8/15

3. Vocational application:

   This recipe serves 8 but only 4 will come to dinner. Write the new amounts.

   MEATLOAF SUPREME

   2 1/2 lb. hamburger
   2 c. cracker crumbs
   3 1/2 T. Worchestershire sauce
   3 eggs
   3/4 c. onion
   2 t. salt
   2 1/4 c. catsup

TASK O: Student will successfully add like fractions

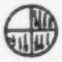
1. Have the students manipulate various concrete materials to get the idea of addition of fractions.

ACTIVITY	MATERIALS/RESOURCES

TASK O: CONTINUED

For example:

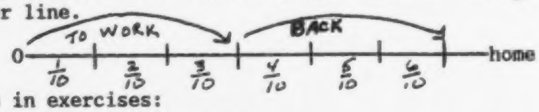
a. The recipe said to use 1/4 apple in the topping and 2/4 apple in the filling. How much apple was used? Use a real apple or a picture.



topping

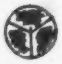
filling

b. John walked 3/10 miles to work at an electrical plant and 3/10 miles back. Show how far he walked using a number line.



c. Shade in exercises:

Shade in 1/4 + 1/4 2/4 = 1/2

Shade in 2/3 + 1/3  3/3 = 1

2. Help the student to deduce, one may express addition as numerators over the same denominator.

For example: 2/3 + 1/3 = 2 + 1/3 or $\frac{2 + 1}{3}$

3. Give students application problems like these:

a. A cook used 1/4 tsp. ginger and 3/4 tsp. cloves. How much spice did she use? (1 tsp.)
b. A builder used 5/8 box of nails on the cupboards and 2/8 box on the kitchen windows. How many were used? (7/8)
c. A mechanic works 4 1/4 hour on one car, 3 3/4 hours on another and 2 1/4 hour on a third. What is the total number of hours worked? (10 1/4)

Follow-up: Give students opportunities to add fractions at home:
Add up the number of hours they have worked on a chore or project.
Add up the number of hours they watch TV in on week.
Add up the number of hours they work on homework.

Discuss the above calculations!

Have students initiate or help with building of a project. This will involve measuring and addition of fractions. (Even putting together a model involves some work with fractions.)

TASK P: Student will successfully subtract like fractions

1. Give the students a variety of problems to do including the following:

a. An electrician had 3/4 inch wire and used 1/4 inch of it. How much was left? (1/2)
b. A cook had 7/8 cup broccoli and used 3/8 cup in a recipe. How much was left? (4/8 = 1/2)
c. A painter had 5/6 gallon of paint left and he used 4/6 gallon to paint a closet. How much was left? (1/6)

ACTIVITY	MATERIALS/RESOURCES

TASK P: CONTINUED

d. A mechanic used 3/8 can of motor oil yesterday and 1/8 can today. How much is left in the can? (1/4)

Follow-up: Send these suggestions to parents if possible.

Continue to provide concrete experiences for the student to work with fractions.

For example: If you use 3/8 box of cereal, in muffins and John eats 1/8 for breakfast, how much cereal is left?

Construct subtraction problems that are necessary in whatever area the student is interested. Some areas might be: cooking, sewing, building, gardening, mechanics, etc.

(Cooking) If we use 1/3 box raisins in cookies, how much is left?

(Sewing) If the seam allowance is 5/8 inch, how much space will be between the seam and the inch line?

(Building) If you work on shelves 2/5 hour today, how much time will be left?

(Gardening) If we plant 1/6 of the turnip seeds today and 3/6 tomorrow, what will be left?

(Mechanics) You are making an axle shaft key 1/4 inch square. But you find a key 1/4 inch by 2/4 inch. How much stock do you have to remove?

TASK Q: Student will successfully add and subtract unlike fractions

1. REVIEW multiples. Multiples are multiplying a number times 1, 2, 3, 4, 5, 6, 7, etc. The least common multiple is the smallest multiple of 2 numbers.

   For example: 4: 4, 8, 12, 16, 20, 24
   5: 5, 10, 15, 20

   Have students find the least common multiple of many different numbers, including:

   6 4

   9 3

2. Instructions: Have the student block out the numerator of the fraction and concentrate on the denominator. (He can use his finger, paper, pencil, etc.)

   Have him look at the two denominators and generate the common multiples. Then circle the least common multiple.

   For example: 1/4 = 4, 8, 12, 16, 20, 24
   +2/5 = 5, 10, 15, 20

ACTIVITY	MATERIALS/RESOURCES

TASK Q: CONTINUED

3. The least common multiple becomes the least common denominator when working with fractions. Have students practice finding the LCD on fraction like these.

$$\begin{array}{l} \frac{y}{6} \\ + \quad \underline{\qquad} \\ \frac{z}{3} \end{array} \qquad\qquad \begin{array}{l} \frac{m}{3} \\ + \quad \underline{\qquad} \\ \frac{n}{10} \end{array}$$

$$\begin{array}{l} \frac{a}{7} \\ + \quad \underline{\qquad} \\ \frac{b}{5} \end{array} \qquad\qquad \begin{array}{l} \frac{c}{7} \\ + \quad \underline{\qquad} \\ \frac{d}{4} \end{array}$$

NOTE
For some students it will be necessary to separate addition and subtraction. The processes are very similar, so are treated as one step.

4. REVIEW equivalent fractions (Task F). Do this to help students prepare to multiply both terms of a fraction.

5. Instruction:

Step 1 - Cover the numerator--look only at the denominator

	Find LCD	Rename to make equal fractions	Add or Subtract
$\frac{2}{3}$	$\frac{\_}{6}$	2 x 2 = 4 3 x 2 = 6	$\frac{4}{6}$
$\frac{1}{+6}$	$\frac{\_}{6}$	1 x 1 = 1 6 x 1 = 6	$\frac{1}{+6}$
			$\frac{5}{6}$

If a student has great difficulty--have her multiply the denominators to find a common denominator.

6. Give students practice problems with at least 2 common denominators.

For example:

$$\frac{2}{6} \times \_ = \frac{\_}{30} \qquad \frac{1}{4} \times \_ = \frac{\_}{12} \qquad \frac{5}{12} \times \_ = \frac{\_}{12}$$

$$\frac{1}{+5} \times \_ = \frac{\_}{30} \qquad \frac{3}{+6} \times \_ = \frac{\_}{12} \qquad \frac{1}{-3} \times \_ = \frac{\_}{12}$$

$$\underline{\qquad} \quad \underline{\qquad} \qquad \underline{\qquad} \quad \underline{\qquad} \qquad \underline{\qquad} \quad \underline{\qquad}$$

7. Vocational application problems:

   a. In a car the cross member is 1/8" and the frame is 2/3" thick. How deep should the hole be to go through both pieces?

ACTIVITY

MATERIALS/RESOURCES

TASK Q: CONTINUED

$$\begin{array}{r} 1 \\ 8 \\ 2 \\ +3 \\ \hline \end{array} \quad + \quad \begin{array}{r} 3 \\ 24 \\ 16 \\ 24 \\ \hline \end{array}$$

$$\frac{19}{24} \text{ inch}$$

b. An electrician has 1/8' wire. He used 2/3' for a hookup. How much is left? (5/24')

c. A carpenter works 2/3 hour hammering, 1/4 hour drilling and 1/2 hour sanding. How many hours did he work?

$$\begin{array}{cc} \frac{2}{3} & \frac{8}{12} \\ \frac{1}{2} & \frac{6}{12} \\ \frac{1}{+4} & \frac{3}{+12} \\ & \hline \end{array}$$

$$\frac{17}{12} = 1\,\frac{5}{12} \text{ hours}$$

TASK R: Student will successfully add and subtract mixed numbers with the same denominator

1. REVIEW adding and subtracting fractions with common denominators (Task O and P).

2. Caution students to first add or subtract fraction, then the whole number.

   For example:

$$\begin{array}{cccc} 2\frac{1}{5} & \frac{1}{5} & 2 & \\ +\,1\frac{2}{5} & \frac{2}{+5} & +1 & \\ & \hline & \hline & \\ & \frac{3}{5} & 3 & = 3\frac{3}{5} \end{array}$$

3. Give students vocational problems including:

   a. A plumber needs pipes these lengths: 15 3/16, 5 5/16, 3 2/16. How much pipe does she need?

   b. An electrician has one wire 15 1/3' long and another 17 2/3'. How much longer is the second wire?

ACTIVITY	MATERIALS/RESOURCES

TASK S: Student will add and subtract mixed numbers with different denominators

1. REVIEW finding a common denominator.
2. Instruction: Use 4-step method.

Find Least Common Denominator		Write Whole Numbers--Rename Fraction	Find Numerator	Add or Subtract
$2\frac{1}{3}$	$\frac{\_}{3}$	$2\frac{\_}{6}$	$2\frac{2}{6}$	$2\frac{2}{6}$
$+3\frac{1}{2}$	$\frac{\_}{2}$	$3\frac{\_}{6}$	$3\frac{3}{6}$	$+3\frac{3}{6}$
				$5\frac{5}{6}$

If student has difficulty--draw out process--or go back to adding and subtracting fractions.

3. Give a number of practice problems.

$5\frac{1}{2}$	$6\frac{1}{7}$	$2\frac{5}{8}$
$-3\frac{2}{3}$	$+4\frac{1}{5}$	$+1\frac{1}{3}$

TASK T: Student will add and subtract a mixed number from a whole number.

1. NOTE: Students often have difficulty subtracting a mixed number from a whole number because they forget to rename.
2. Have students find problems in which they will need to rename on a worksheet and circle them in red. Then work them.

Follow-up: Have students add number of hours they work babysitting, or doing lawn work and total weekly. For example: "I babysat 3 hr. Monday, 1/2 hr. Tuesday, 4 1/2 hr. Friday = 8 hr." Students can keep a record of their hours and earnings.

3. For example:

For example:	Rename	Equivalent Fraction
3	$2 + 1$	$2\frac{4}{4}$
$-1\frac{1}{4}$		$-1\frac{1}{4}$
		$1\frac{3}{4}$

Follow-up: Ask students to keep track of amounts they use. For example: Amount of oil in the car. (6 cans or 5 1/3 cans)

4. Vocational application:

   a. A carpenter has boards 6', 5 3/4' and 7 2/3'. How much do they total? ________

ACTIVITY	MATERIALS/RESOURCES

TASK T: CONTINUED

b. An auto mechanic has 15 cans of oil. He uses 6 2/5 cans in the morning. How much is left to use? ________

TASK U: Student will subtract mixed numbers where he/she must rename two times

1. REVIEW renaming to make a common denominator (Task S). REVIEW renaming whole numbers to improper fractions.

2. Go over many examples with the student.

	Common Denominator		Rename Whole Number	Subtract
5 1/4	2/8	Can't	4 + 8/8 + 2/8	4 10/8
-3 1/3		subtract		-3 3/8
	3/8	so	3 3/8	1 7/8

3. Use colored pencils to show graphically the renaming.

6 1/5	3/15	5 + 15/15 + 3/15	= 5 18/15
-3 1/3	5/15		-3 5/15
			2 13/15

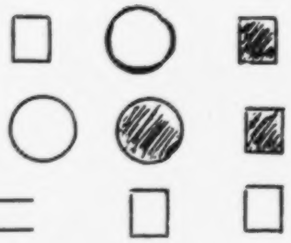
Graph paper also helps keep numbers aligned properly. — Graph paper

4. Do vocational application problems. — Worksheet U4

*This is a difficult concept and may take extra time and/or reinforcement.

PRE-TEST 1
Theory and Fraction Expression

Related Task



(c) 1. a. There are _____ figures in this group.
b. _____ of the _____ are circles.
c. _____ of the _____ are squares.
d. What fraction is circles? _____
e. What fraction is squares? _____
f. What fraction of the squares are shaded? _____
g. What fraction of the circles are shaded? _____

(B) 2. 8 is the denominator and 3 is the numerator, what is the fraction? _____

(A) 3. Define what a fraction is in your own words.

(A) 4. Give one example of a fractional set in our room. (For example, there are 5 windows and 2 are open. 2/5 of the windows are open.)

(D) 5. Circle the fractions equal to one.

$\frac{6}{6}$ $\frac{3}{5}$ $\frac{15}{15}$ $\frac{100}{100}$ $\frac{17}{15}$ $\frac{25}{25}$

(F) 6. Find 5 fractions equal to 1/3. Find 5 fractions equal to 1/4.

$\frac{1}{3} = \frac{\_\_}{6} = \quad = \quad = \quad =$ $\frac{1}{4} = \quad = \quad = \quad = \quad =$

(G) 7. Use the signs <,>, and = to compare these fractions.

1/4 ____ 1/3 1/6 ____ 1/8 2/5 ____ 2/8

3/8 ____ 5/6 2/3 ____ 3/4 1/16 ____ 2/32

(H) 8. Find the prime factors of the following numbers.

56
/\
 /\
/\

48
/\
/\ /\
/\

81
/\
/\ /\

(I) 9. Express the following fractions in their simplest form.

8/10 = ____ 15/20 = ____ 7/21 = ____

4/6 = ____ 16/24 = ____ 7/49 = ____

(J) 10. Express the following improper fractions as mixed numbers.

15/10 = ____ 26/3 = ____ 45/5 = ____

8/8 = ____ 17/4 = ____ 81/9 = ____

PRE-TEST 2
Actual Problems

(K,L) 11. Multiply and express in simplest form.

$\frac{3}{4} \times \frac{1}{5} =$ $\qquad$ $\frac{5}{9} \times \frac{3}{4} =$ $\qquad$ $\frac{1}{2} \times \frac{1}{2} =$

$1\frac{2}{3} \times \frac{1}{4} =$ $\qquad$ $2\frac{1}{2} \times 3\frac{1}{4} =$ $\qquad$ $\frac{3}{4} \times 2\frac{5}{8} =$

(M,N) 12. Divide and express in simplest form.

$\frac{3}{8} \div \frac{1}{4} =$ $\qquad$ $\frac{5}{6} \div \frac{5}{6} =$ $\qquad$ $\frac{4}{9} \div \frac{2}{3} =$

$2\frac{5}{8} \div \frac{1}{2} =$ $\qquad$ $3\frac{1}{6} \div 2\frac{1}{7} =$ $\qquad$ $3\frac{3}{4} \div \frac{2}{3} =$

(O, Q, R, S) 13. Add and express in simplest form.

$$\begin{array}{r} 3\frac{1}{5} \\ +4\frac{2}{5} \\ \hline \end{array} \qquad \begin{array}{r} 5\frac{5}{7} \\ +3\frac{2}{7} \\ \hline \end{array} \qquad \begin{array}{r} 2\frac{5}{8} \\ +1\frac{1}{3} \\ \hline \end{array} \qquad \begin{array}{r} 6 \\ +2\frac{7}{8} \\ \hline \end{array} \qquad \begin{array}{r} \frac{4}{7} \\ +\frac{1}{3} \\ \hline \end{array}$$

(P, Q, R, S, T, U) 14. Subtract and express in simplest form.

$$\begin{array}{r} \frac{5}{7} \\ -\frac{2}{7} \\ \hline \end{array} \qquad \begin{array}{r} \frac{1}{2} \\ -\frac{1}{4} \\ \hline \end{array} \qquad \begin{array}{r} \frac{3}{5} \\ -\frac{1}{5} \\ \hline \end{array} \qquad \begin{array}{r} 3\frac{1}{8} \\ -1 \\ \hline \end{array} \qquad \begin{array}{r} 2\frac{1}{8} \\ -1\frac{5}{8} \\ \hline \end{array}$$

$$\begin{array}{r} 3\frac{1}{6} \\ -1\frac{2}{3} \\ \hline \end{array} \qquad \begin{array}{r} 5\frac{3}{8} \\ -2\frac{3}{5} \\ \hline \end{array} \qquad \begin{array}{r} 6 \\ -2\frac{5}{8} \\ \hline \end{array}$$

PRE-TEST 3
Application Problems

Letters in ( ) refer to Task Analysis Step.

(C) 1. 6 tools in all
2 are pliers
______ of the tools are pliers

(C) 2. 4 cars
50 vehicles
_____ of the vehicles are cars

(D) 3. An auto mechanic wants to find a fraction equal to 1. Is it 3/4, 2/3, or 16/16? _____

(F) 4. A carpenter is cutting a joist that is 3 5/8 in. thick. How many 16ths of an inch are in 5/8 inch?

(F) 5. How many 1/16 inch are there in a 1/2 inch diameter bolt?

(G) 6. Which socket is larger 1/2 or 5/16?

(J) 7. A cook put in 11 quarter cups of flour in a recipe. How many whole cups did he use?

(K) 8. Ms. Smith is an electrician. She has 1/2 ft. of copper wire and used 5/8 of it. How much did she use?

(L) 9. What is the area of a shelf 2 1/2 ft. by 7 3/4 ft?

(M) 10. A mechanic has a bolt 3/4 inch long. He needs to divide it in half. How long will each portion be?

(N) 11. A cook needs to divide a recipe in half. She has 6 3/4 lb. of hamburger. How much would be used in 1/2 of the recipe? (Careful: 6 3/4 - 2)

(O) 12. In her recipe the cook uses 1/4 tsp. ginger and 3/4 tsp. cloves. How much spice does she use all together?

(P) 13. A mechanic used 3/8 can of motor oil yesterday and 1/8 can today. How much is left in the can?

(Q) 14. An electrician has 7/8 ft. wire. He used 2/3 ft. for a hook-up. How much is left?

(R) 15. A plumber needs pipes these lengths: 15 3/16, 5 5/16, 3 2/16. How much pipe does he need?

(T) 16. A cook has 5 cans of peaches. He uses 3 1/2 in some pies. How much is left?

(U) 17. A gasoline tank contains 20 1/2 gallons of gas. The owner uses 9 2/3 gallons on a trip. How much gas is left?

ANSWER SHEET

PRE-TEST 1

1. a. 8
   b. 3,8
   c. 5,8
   d. 3/8
   e. 5/8
   f. 2/5
   g. 1/3

2. 3/8

3. A part of something

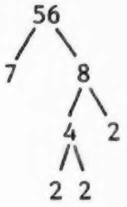
4. Accept reasonable answers

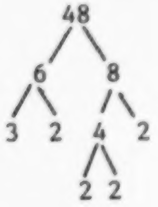
5. $\frac{6}{6}$ $\frac{15}{15}$ $\frac{100}{100}$ $\frac{25}{25}$

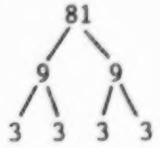
6. Check for equivalency

7. < > >
   < < =

8.







9. 8/10 = 4/5
   4/6 = 2/3
   15/20 = 3/4
   16/24 = 2/3
   7/21 = 1/3
   7/49 = 1/7

10. 1 1/2, 8 2/3, 9
    1, 4 1/4, 9

PRE-TEST 2

11. 3/20, 15/36 = 5/12, 1/4
    5/21, 8 1/8, 1 31/32

12. 1 1/2, 1, 2/3
    5 1/4, 1 43/90, 1 7/8

13. 7 3/5, 9, 3 23/24, 8 7/8, 19/21

14. 3/7, 1/4, 2/5, 2 1/8, 1/2, 1 1/2, 2 31/40, 3 3/8

PRE-TEST 3

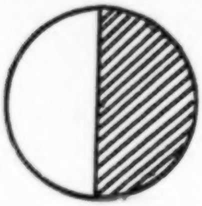
1. 2/6 = 1/3
2. 4/50 = 2/25
3. 16/16
4. 10/16
5. 8/16
6. 1/2
7. 2 3/4
8. 5/16
9. 19 3/8 sq. in.
10. 3/14
11. 3 3/8
12. 1 tsp.
13. 1/2
14. 5/24
15. 23 5/8
16. 1 1/2
17. 10 5/6

WORKSHEET B5

FRACTION PRACTICE

Name the fractional part shaded.

A CARPENTER SAWS OUT THE FOLLOWING:



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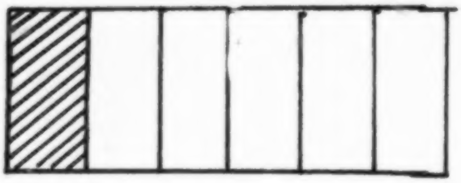

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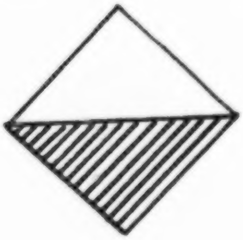

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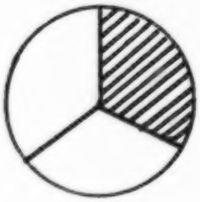
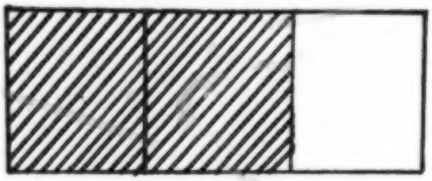
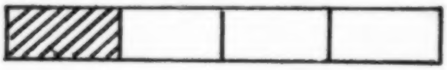


____

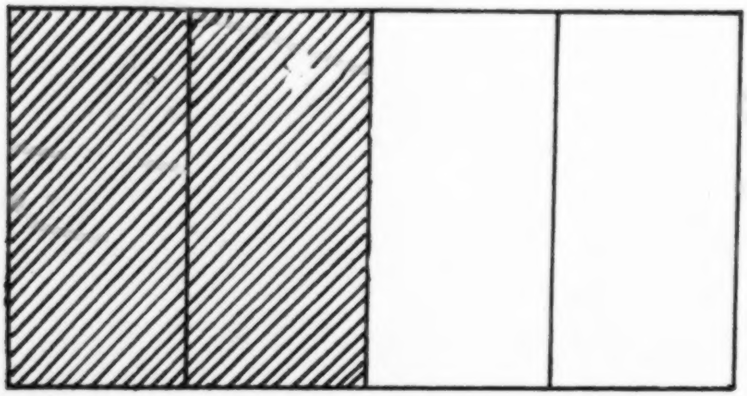
A BUILDER NEEDS TO KNOW HOW MUCH OF THE FOLLOWING HE/SHE NEEDS:
(Fill in the blank.)



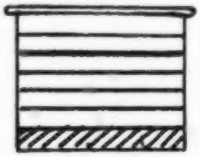
____________board



____________ copper tubing



____________room



________ can of paint

WORKSHEET B5 Continued

1. The top number of a fraction is called a ____________________.
2. The bottom number of a fraction is called the ________________.
3. A fraction is a ______________ of a whole.
4. If you divide something into 6 parts, the numerator will be _____.
5. If you divide something into 3 parts, the numerator will be _____.
6. In the fraction 10/24, the unit has been divided into _____ parts and you have _______ of them.
7. Define what a fraction is in your own words.

8. Give one example of a fraction from daily life.

9. In the fraction 1/4, tell what each number means.

   1 =

   4 =

10. Express some set in this room in a fraction.

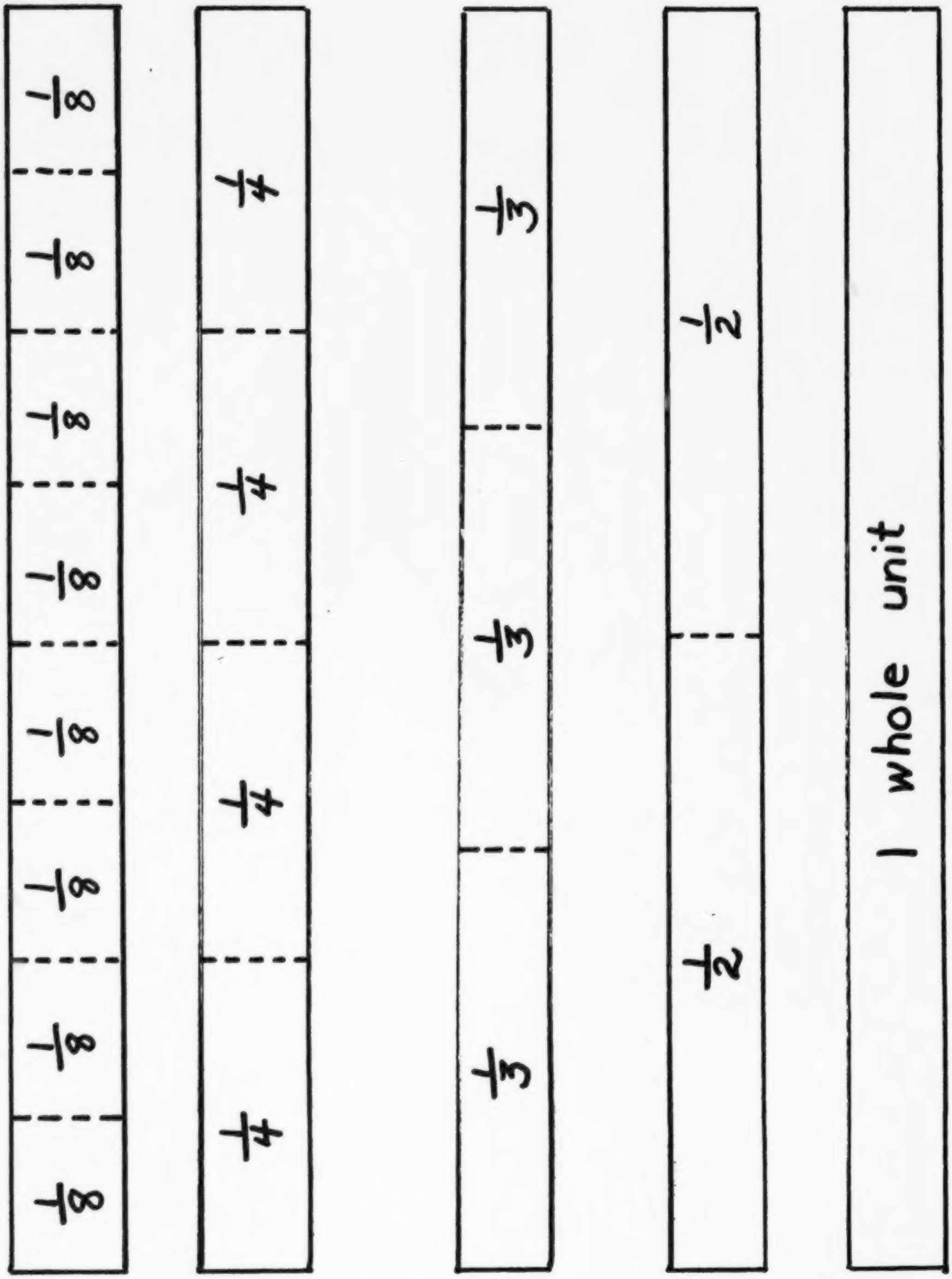
    For example: There are 5 chairs and 3 are vacant. 3/5 of the chairs are vacant.

ANSWER KEY:

1. numerator
2. denominator
3. part
4. 6
5. 3
6. 24,10

7 - 10. Accept reasonable answers.

WORKSHEET D1


1/8
1/8
1/8
1/8
1/8
1/8
1/8
1/8
1/4
1/4
1/4
1/4
1/3
1/3
1/3
1/2
1/2
1 whole unit

WORKSHEET H2

Make factor trees for the following:

6

12

9

15

18

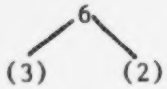
15

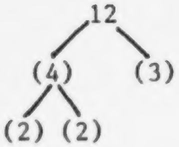
Find the factors for the numerator and denominator. Then find the common factors and the greatest common factor.

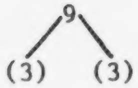
	FACTORS	COMMON FACTORS	GREATEST COMMON FACTOR
$\frac{15}{30}$	1, 15, 3, 5, 1, 30, 5, 6, 3, 10	1, 3, 5	5
$\frac{8}{24}$			
$\frac{12}{20}$			
$\frac{30}{45}$			
$\frac{21}{49}$			
$\frac{20}{28}$			

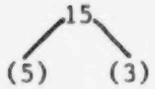
ANSWERS TO WORKSHEET H2

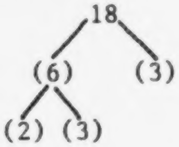
Make factor trees for the following.

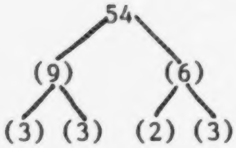












Find the factors for the numerator and denominator. Then find the common factors and the greatest common factor.

	FACTORS	COMMON FACTORS	GREATEST COMMON FACTOR
15/30	1, 15, 3, 5 1, 30, 5, 6, 3, 10	1, 3,	5
8/24	1, 8, 2, 4 1, 24, 4, 6, 12, 2	1, 2, 4	4
12/20	1, 12, 3, 4, 6, 2 1, 20, 10, 2, 4, 5	1, 2, 4	4
30/45	1, 30, 6, 5, 10, 3, 15, 2 1, 45, 5, 9	1, 5	5
21/49	1, 21, 7, 3 1, 49, 7	1, 7	7
20/28	1, 20, 5, 4, 10, 2 1, 28, 4, 7, 14, 2	1, 2, 4	4

WORKSHEET I4

PRACTICE PAGE FOR COMPARING FRACTIONS AND SIMPLEST TERMS

1. One piece of pipe is 1/2 inch, one is 5/8 inch. Which is bigger? (Hint: 1/2 = ?/8ths?)

2. One recipe call for 2/3 cups of flour. One calls for 4/6 cups of flour. Which is more? BE CAREFUL! __________

3. One bolt is 3/8 inch and one is 1/4 inch. Which is smaller? __________

4. One wire is 3/8 inch in diameter and one is 5/16 inch. Which is larger? __________

5. A carpenter has made the following calculations. He needs to find the simplest terms for his answers. Can you help him?

   Cut board 2 6/12 ft. = __________

   Cut pipe 5 4/12 ft. = __________

   Cut window 2 10/16 ft.= __________

6. An auto mechanic needs a wrench for a job that is 10/16 in. diameter, but her wrenches are calibrated in 1/8 inches. Which should he use?

7. How many 1/16 inches are there in a 3/4 inch piston pin?

8. What is the size of a socket 1/8 inch larger than 1/2 inch?

9. What is the size of a nut 1/4 inch smaller than 5/8 inch?

ANSWER KEY:

1. 5/8 inch
2. same
3. 1/4 inch
4. 3/8 inch
5. 2 1/2, 5 1/3, 2 5/8
6. 5/8 inch
7. 3/4 = 12/16
8. 1/2 = 4/8 + 1/8 = 5/8
9. 1/4 = 2/8 5/8 - 2/8 = 3/8

Worksheet U4

VOCATIONAL APPLICATION PROBLEMS

1. A gasoline tank contains 20 1/2 gallons of gas. The owner uses 9 2/3 gallons on a trip. How much gas is left? (10 5/6)

2. The following amounts are taken from a 5 gallon can of oil: 1/2 gal, 1 2/3 gallon, 2 1/3 gallon. How much is left? (1/2)

3. A mechanic needs 4 bolts that are 1/2" in diameter and 5/8" long. All she can find are 4 bolts that are 1/2" in diameter and 1 1/4" long. How much must she cut from each bolt? (5/8")

4. A cook has 15 1/3 lb. of potatoes. He uses 5 3/4 lb. in potato soup. How much does he have left? (9 7/12)

5. A carpenter needs to find the following distances:
   A shelf is 6 1/4 ft. long. She needs to cut off 4 3/8 feet. How much will be left? (1 7/8)
   A piece of molding is 18 1/3 ft. long. She needs to cut one piece 5 2/3 feet, and another piece 6 1/6 feet. How much will be left? (6 1/2)

6. Make up at least 3 problems that you might encounter in work you wish to do. Trade with a friend and work the problems.

Bibliography (Annotated)

Additional Practice Problems:

Angeles, Elenanor, Real Life Math Skills, (Scholastic), New York.

Duncan, et. al., Modern School Mathematics Structure and Use, (green copy and brown copy), Houghton Mifflin Co., Boston. Available in Junior Highs.

Geir, Alvin & Lamm, Nathaniel, Mathematics and Your Career, AMSCO School Publications, New York, 1978. Excellent source of application problems, available from the VRE.

Goozner, Calman, Arithmetic Skills Workbook, SMSCI School Production, 1973. Available at Hickman, has many application problems.

Lankford and Goe, Consumer Activities Book, Harcourt, Brace Jovanovitch, 1974. Available at Ellis Library. This book has some good application problems for consumers.

Moore, George, Practical Problems in Mathematics for Automotive Technicians, Delmar Publishers, Albany, New York. Available from the VRE. This book has difficult, but very realistic problems for auto repair.

Rausmussen, Steven, Key to Fractions Books 1-4, Key Curriculum Project, 1980. Available from the VRE, this book is self-directed. It has a clear, concise approach to fractions. It is a good resource if the students you teach are having difficulty.

Studebaker, Gordon & Studebaker, John, Scholastic Skills Book, Computational Skills K, FRACTIONS, Scholastic Books, 1980. Rather simplistic. This book offers lessons in fraction theory and adding and subtracting fractions. Available from Scholastic, or at Jefferson Junior High.

Ideas for Teaching:

Engleman, Siegfried, Preventing Failure in the Primary Grades, SRA, 1969. Has a very precise way of introducing fractions that may be helpful to students who are having great difficulty.

Marks, John, Purdy, Kinney and Hiatt, Teaching Elementary School Mathematics for Understanding, McGraw-Hill Book Company, 1975. Has many hands-on experiences to introduce fractions.

Smith and Backman (ed), Games and Puzzles for Elementary and Middle School Mathematics, 1975. These readings from the Arithmetic Teacher offer lots of games and activities for reinforcement.

Games

Junge, Charlotte, A Game of Fractions.

Rode, Joann, Make a Whole-- A Game Using Simple Fractions.

INSTRUCTIONAL MODULE

ACCESS SKILL: PHYSICAL DEMANDS MOVEMENTS

VOCATIONAL AREA:
Auto Mechanics
Machinist
Carpentry
Heating and Air Conditioning
Offset Lithography
Diesel Mechanics
Welding
Auto Body

TASK ANALYSIS STEPS: A-F

ACTIVITY	MATERIALS/RESOURCES
TASK A: The student will bend, reach, stoop, push, and pull appropriately without assistance	
1. Introduce the lesson to the students by telling them how important it is to move the body in the safest and best manner. Ask students to demonstrate how they would pick up a box on the floor, push a heavy object (such as a refrigerator), lift a heavy object (such as a television, etc.).	
2. After the students have shown their way of lifting, stooping, pushing, pulling, and bending, demonstrate the appropriate way through miming these methods. (act out the wrong way and then the right way. Do it in silence - possibly even in a dark room with a bright light on you. Better yet, have a mime come in to your classroom to demonstrate for you.)	Guest mime
3. Put out some large objects in your room and show the students the proper ways of lifting, moving, or rearranging the objects. For instance, lift a chair the proper way - demonstrate the proper method of bending at the knees and keeping the back straight and then lifting--using the arms. Or, ask the students to push the file cabinet and point out that when you get a really heavy object such as a file cabinet you should plan ahead and ask someone to help you.	Things to lift: desk, chair, file cabinet, large boxes (empty and full) people, small objects off the floor, light weight and heavy objects up high on a shelf
4. Use Worksheets A4 and A4a to demonstrate to the students the proper methods of lifting.	Worksheets A4, A4a
5. Show the students the film: "A New Way to Lift" which demonstrates the proper methods of lifting and the results of improper lifting. (8 minute film)	A New Way to Lift" available from the Academic Support Center, UMC
6. Invite a guest speaker into the classroom to discuss the proper methods of lifting and why it is done that way. Physical therapists are doing more and more of this type of activity and might even consider putting on an evening program for the school or the class and their parents.	Guest speaker: Physical Therapist
7. One at a time, ask the students to demonstrate the proper methods they have learned. Review this lesson often to make it become a healthy habit.	
TASK B: The student will lift up to and including 50 pounds of weight	
1. After learning how to lift, it is important to gradually learn how much you can lift. Before doing this portion of the unit, make sure students have no physical problem which would keep them from being able to lift 50 pounds.	

ACTIVITY	MATERIALS/RESOURCES
TASK B: CONTINUED	
2. Introduce the lesson to the students by asking them what kinds of workers in their area of vocational choice might have to lift 50 pounds. After you have named a few, ask the students why they think it would be important to learn to lift up to 50 pounds. Students should recognize that workers in horticulture, auto service, building trades, etc. have to lift heavy objects in order to do their job. There is not always a machine or someone else to do the job. Somewhere along the line, you are going to be that "somebody else".	
3. Test the students' strength by handing each student a 5 pound sack of flour, sugar, or sand. Ask the students to lift the 5 pound bag as high as he/she can comfortably and time him/her to see how long he/she can hold that bag. Gradually increase the time the bag can be held by each person.	5 pound bag of sand, flour, sugar, etc.
4. Once the student can lift the 5 pound bag of flour with both the left hand and the right independently for 3 minutes, work up to the lifting of 10 pounds of the same or similar weight. the student to lift 10 pounds of weight with his/her right arm for up to 2 minutes. Check each student individually.	10 pound bag of sand, etc.
5. Fill a bag with 20 pounds of sand and demonstrate to each student the proper way of lifting (see previous activity) 20 pounds using both arms to lift. Require each student to lift 20 pounds of weight and hold it to the count of 60.	
6. Put 30 pounds of weight in a box and demonstrate the proper way of lifting. Each child should lift the 30 pound weight and put it back down slowly--without dropping it. Once the student has demonstrated the proper way to lift such a weight, ask him/her to lift the 30 pound weight 10 times without stopping.	
7. Give the students some practical experiences lifting weights of 30, 40, and 50 pounds by assigning him/her to plant a small tree (30-40 pounds - including dirt), or lifting other heavy objects around the classroom and home.	Heavy items that might be used in vocational projects
8. If your school has a weight room, make use of it. Ask the coach or one of the regular weight lifters to demonstrate the use of the weight lifting machines and provide an opportunity for students to work out on it daily or every other day.	Weight room, guest demonstration
9. Demonstrate the appropriate way to do chin-ups. Have the students try to do at least 5 chin-ups each day.	Chin-up bar
10. Invite a professional weight lifter or tai-kwan-do instructor to demonstrate their muscles and strength and talk about how they keep in shape.	Guest speaker
TASK C: The student will lift up to 50 pounds of weight repeatedly for a prolonged period of time	
1. Once the student has developed the strength he/she needs to lift 50 pounds of weight, discuss the need to be able to lift 50 pounds of weight repeatedly. (Many jobs do not require that you just lift one thing, but probably many heavy things, and you must be strong enough to do so.)	

ACTIVITY	MATERIALS/RESOURCES
TASK C: CONTINUED	
2. Using bar bells, arm weights, chin-ups, push-ups, and large boxes, require the students to lift up to 50 pounds of weight 12 times per hour (once every 5 minutes). Check the student to be sure he/she is using proper body position and doesn't start to use his/her body improperly after a few lifts.	Bar bells, large heavy boxes, small heavy boxes, buckets of paint or water, bails of hay, etc.
3. Encourage the student to lift heavy objects in the classroom whenever heavy things need to be lifted. Make sure the student is using the best possible methods to lift.	
TASK D: The student will demonstrate agility	
1. Introduce the lesson by telling the students that they are going to work on becoming agile. Ask if anyone knows what agility is and why they need that ability. (Ability to move with ease and quickness is needed by everyone in order to show interest, to adequately perform at work, to complete tasks, etc.) Discuss a person who moves very slowly and demonstrate. Then ask why that person might not get the job done. Then ask one of the students who is usually very slow or lacking in agility to demonstrate the opposite. Make sure he/she adequately demonstrates smooth, quick movements.	
2. Discuss what would require agility in the vocational area for which they are preparing.	
3. Show the many forms of agility and movement as a graceful form of expression by showing "Learning Through Movement," a 30 minute film.	"Learning Through Movement" is available from the Academic Support Center - UMC
4. Practice the skills learned in Tasks A-C and increase the speed with which the task is completed. Check speed with a stop-watch.	Stop-watch
5. Using an aerobic record, demonstrate various moves in aerobics to the students and let them practice the moves until they have an idea of how to move their body upon command. Then turn on the music and begin moving. There are several records out on the market and your school library might have copies of various ones you'd like to use. (Be sure to practice the steps ahead of time).	Aerobics record, cassette tapes or videos
6. Discuss how quick jerky movements may be fast and might get the job done, but might cause accident or injury. Moving objects around on a cart requires more than simple pushing It also requires concentration and planning. For example: If we were to move a cart with a television set down the hallway and not look where we were going, we might hit a bump or run into someone and the TV would fall off - shattering! Practice moving empty boxes on a cart, then have light-weight non-breakable objects in the boxes. Later put heavy objects on the carts and assign the students to move them through the hallways quickly, but safely--telling ahead of time what they are going to do to insure safety of that item (such as holding onto the object just in case we do hit a bump, etc.).	Moving cart, dolly, boxes, light-weight non-breakable objects, heavy objects
Contact the parents of the students and explain to them the lesson on agility. Ask that they watch their son or daughter at home and remind them to practice agility--to move quickly, smoothly, and gracefully.	

	ACTIVITY	MATERIALS/RESOURCES
	TASK E: The student will demonstrate good eye-hand coordination	
1.	Explain and introduce the lesson on eye-hand coordination by timing the students' ability to screw and unscrew screws on a board. This requires skills other than eye-hand coordination, but also requires that skill and is a fun way to introduce the lesson. Or have the students put the correct pegs into holes as rapidly as possible.	Screws in board, screwdriver, peg board and golf tees or pegs
2.	Ask the students to be honest with themselves about how much trouble they had completing this task in a given period of time. This gives them some indication as to why they are working on this task. Discuss various reasons why eye-hand coordination is important and what jobs require such a skill. Impress upon the students the need to learn this skill.	
3.	Give each student a piece of cardboard with a simple shape on it. Assign the students to trace around the shape and then cut it out. Make sure the student can cut out the shape without any odd angles or frayed edges before moving on to a more difficult shape. Begin with circles, squares, and triangles and progress to tracing objects such as screwdriver, hammers, etc. and cutting them out.	Carboard, pencils, scissors, screwdriver, hammer, etc.
4.	Break the students into pairs and give each pair a 200 piece puzzle (fairly large pieces) and see who can finish first. The pair that finishes first gets to move on to putting together a 500 piece puzzle. Time students to see which group can finish first. Because this might take several days to complete and can become monotonous after a short period of time, allow approximately 20 minutes per day for this activity.	200 and 500 piece puzzles, timer
5.	Drill 24 holes in a small board and give the student 24 nuts and bolts. Time the students performance on putting each nut and bolt in each hole and tightening. Eventually give the students a timer or stop watch and allow them to time themselves to cut down on the amount of time it takes to complete this task.	6"x 6" board with 24 holes drilled in it, 24 nuts and bolts, timer or stop watch
6.	Practice writing skills and work toward forming the letters accurately. Accept only papers with accurately formed letters. Some students might benefit by using a pencil gripper - these are available for the student to purchase at the University Book Store.	Pencil and paper
7.	Decide on a theme for improving eye-hand coordination and allow the students to develop a bulletin board display using some of their skills and showing improvement. Encourage them to trace from pictures, cut items, build small displays for the board, etc.	Paper, pencils, scissors, hammer, nails, screwdriver, etc.
	TASK F: The student will accurately determine left from right	
1.	When teaching left/right discrimination with the junior high/high school student, remember to keep the skills fairly interesting and limit the time. Work with the student on a daily basis for short periods of time to learn the skill with little frustration. Begin with simply telling the student that he/she is going to learn to tell left from right. Discuss the reasons why this would be necessary (to know which tire to change, which hand to use, which direction to turn, how to open a lock, where to turn a car, etc.). Spend as much time as is needed in order for the	

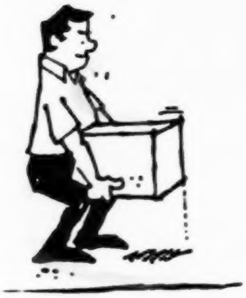
ACTIVITY	MATERIALS/RESOURCES
TASK F: CONTINUED	
student to correctly raise the hand called for 9 out of 10 times. For example: The teacher would say, "Raise your right hand." The student should immediately raise his/her right hand without hesitation. If there is any hesitation, you cannot count that time as accurate. Repeat until the student has raised the correct hand 9 out of 10 times.	
2. Once the student is able to do the above, ask him to pick up the items you name with the correct hand. For example: "Pick up the hammer with your right hand and the nail with your left." The student should do this correctly (even when you switch which hand is to pick up which item), 9 out of 10 times.	Hammer, nails, etc.
3. If the student is having trouble with any part of the activity stand him/her in front of a mirror and mark on the full-length mirror the shape of his body. Draw a line down the center of the shape and mark one side right and the other side left. Let the student stand in front of the table until he/she is able to do the tasks without hesitation.	Magic marker, full-length mirror
4. Place 2 items in front of the student (a pot and some soil, a hammer and some nails, a screwdriver and some screws, a pencil and some paper, etc.) Ask the student to pick up one item with one hand and the other item with the other. The student should at this point tell as he picks up the item which hand he/she is using. There should be no hesitation in the accuracy in 9 out of 10 times.	Flower pot, soil, screws, screwdriver, hammer, nails, pencil, paper, etc.
5. If the student is having trouble at this point you might try outlining the student's body on the chalkboard and labeling one side left and one side right. Tell the student that he/she is facing you, so which side would be the right side of his/her body and which would be the left. If he/she is standing with back to you, he/she should be able to quickly tell which is left and which is right.	Chalkboard, chalk
6. Plan a project (a design of a garden, a model house made of cardboard, etc.). Write directions as to where the student should place certain items in his project. For example: to the right of the raddishes you should plant the lettuce; to the left of the kitchen should be the bathroom; put the couch against the front wall of the living room on the right side, etc.	Materials needed will vary according to the project selected
7. Using game pieces from Monopoly, place the houses on a make-believe town that you and the students have drawn on cardboard. Give the students assignments as to where to place the houses. Later have the student tell you where he/she placed certain houses on that game board.	Poster board, Monopoly game pieces

Worksheet A4

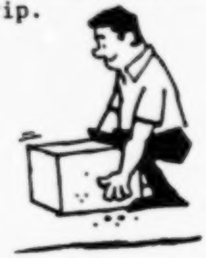
Your backbone or spinal column is the nerve network of your entire body. The spinal column is designed to support the upper section of the body, but the muscles in the back are not designed for lifting and severe strain. The back muscles are flattened and offer support to the spinal column. By contrast, the muscles in your upper thighs and lower leg are the largest in your body--and the strongest. They are designed for running, pulling, jumping, and lifting. You must learn to use your legs to lift--not your back.

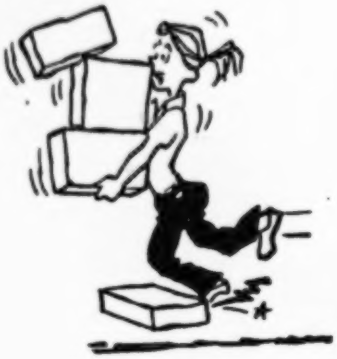
When picking up a carton--even one that appears light in weight--bend your knees and let your leg muscles lift the weight. Keep your back in a straight line. Strain comes from bending the back slightly at an angle when lifting. Even more dangerous is to twist the back slightly to one side when lifting. A full bend is better than a half bend (Luter, 1979).

Lift the load straight up--smoothly and evenly. Pushing with your legs, keep the load close to your body.



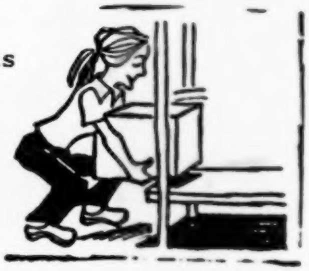
Setting the load down is just as important as picking it up. Using leg and back muscles, comfortable lower load by bending your knees. When load is securely in place, release your grip.

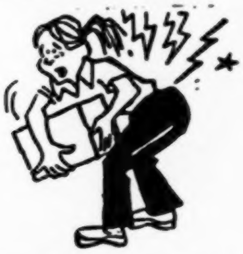




Stack material in such a way as to permit full view while carrying.

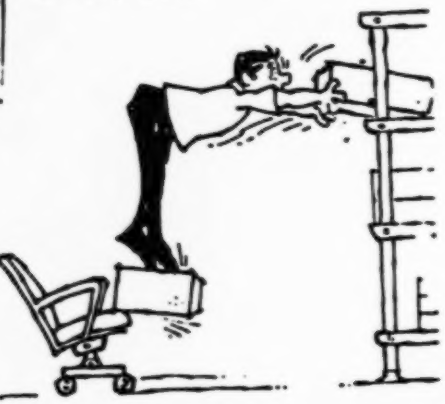
Avoid strain by storing heavy objects at least 12 inches above the floor.





Avoid awkward positions or twisting movements while lifting.

Overreaching and stretching to reach overhead objects may result in strains or falls. Use a ladder instead of chairs, boxes, etc.



Worksheet A4a

PROPER LIFTING TECHNIQUES WORKSHEET

1. Size up the load to be lifted. Do not even attempt to lift a large load alone. If you have any doubt about your ability to lift an object, ask for assistance.

2. Make sure you are well-balanced. Your feet should be apart to give you a broad base of support if you are lifting a heavy object or person.

3. Move close to what you are to lift. Do not reach for any object that is up high or over far. Get your body close to the object to be lifted. If it is up high, get on a ladder. (Use the proper method of climbing a ladder. See the Safety Module.)

4. Keep your back straight. Line up your back so you don't strain it. Bend at the knees and hips--NOT the back.

5. As you lift, straighten your legs. When you bend to lift something, bend your knees. To lift it, straighten your legs.

6. If you need to turn, shift the position of your feet, but do NOT turn your body. Twisting injures muscles.

7. If you are lifting with someone, lift smoothly. This avoids strain on your back which you would get from jerky movements. Count with the person to make sure the lift is smooth.

8. Push or pull a heavy object whenever possible. It is easier and safer.

9. Remember to use these skills all of the time to keep yourself safe.

INSTRUCTIONAL MODULE

ACCESS SKILL: THE STUDENT WILL RECOGNIZE AND READ BLUEPRINTS

VOCATIONAL AREAS:
Carpentry
Electronics
Machinist

TASK ANALYSIS STEPS: A - L

ACTIVITY	MATERIALS/RESOURCES
TASK A: Student will accurately define "blueprints"	
1. Introduce the unit on blueprints to the students by showing transparencies of blueprints or actual blueprints. Discuss with the students the need for blueprints in order to build an object. Ask student to think of another word for a blueprint (drawing, print, sketch, design). Explain to the student and write on the chalkboard, the definition of a "blueprint". (A blueprint is a copy of a drawing which tells the mechanics or technicians what the object to be built will look like. Blueprints tell the workers what size and shape the object will be as well as which materials it will be made of and the finish it will receive.)	Make transparency of Worksheet A1
TASK B: Student will recognize and label blueprints	
1. Explain to the students that a blueprint shows the size and shape of an object by each view (front, top, back, bottom, and sides). Ask students to visualize their neighbor's head in a glass box. Then ask each student to draw all 6 views of their neighbor's head which would appear in the box. See Worksheet B1.	Worksheet B1
2. Discuss with the student who uses blueprints and why (such as contractors, automobile and aircraft workers, etc.) Ask if they know anyone who is in one of these lines of work.	
3. Invite a guest speaker to come in to speak to the class on blueprints and how he/she uses them. Ask him/her to bring in a few blueprints for the students to view.	Guest speaker (Drafting instructor, etc.)
4. Show the student pictures of blueprints and finished products.	Transparencies of blueprints, overhead
TASK C: Student will become familiar with how blueprints are made	
1. Explain to the students how a blueprint got its name, but first ask if they have any idea how it got its name. If no one knows, explain that for many years it was a process where white lines were printed on a blue background, so everyone called it a blueprint. Then further discuss how the print is made: An original drawing is made on transparent paper.	Worksheet C1
2. The original drawing is then placed over a sheet of sensitized paper and exposed paper then goes through a developing process and becomes a finished print. Show students overhead of C1 (print making machine). If possible, take the students to a place where prints are made.	Overhead projector, transparency of Worksheet C1

ACTIVITY	MATERIALS/RESOURCES
TASK D: Student will accurately read the title on blueprints	
1. Ask the students if they have any idea where the title is located on two of the enclosed blueprints. If they can locate it, ask one student to name that blueprint figure. If they cannot find it, ask them to look for the box of writing (usually located in the lower right hand corner of the blueprint and usually what appears if the print is folded correctly.) Show the students any of the blueprints (D1a - D1c). Underline in red the title as in Blueprint D1a. Explain to the students that the title is brief but descriptive and clearly stated for easy identification. The title starts with the name of the part or assembly and is followed by a description of that part. When we read the title, we read the descriptive part first. For example: Jack, Spring would be read: Spring Jack	Worksheets D1a-D1c
2. Give students Worksheet D2-D2d and ask them to circle the title of the print and then rewrite it as it would be read aloud.	Worksheet D2-D2d
TASK E: Student will accurately locate drawing numbers on a blueprint	
1. Explain to the student(s) what a drawing number is: "A drawing number is used to identify and control the blueprint. It is also used to designate the part shown on a blueprint. It is usually coded to indicate the department, model, group, serial number, and dash numbers. For example, a drawing number of 12M3236-4 would tell us the 12th department will make a model M32, group 3, serial number 6, and dash number 4 or a left hand part.	
2. On the same blueprints as were used in Task D, locate the drawing numbers.	
TASK F: Student will accurately read title block and notes on a blueprint	
1. Explain to the students that the title block is to provide supplementary information on the part to be made and gives information which will help identify the print. It is usually located in the lower right hand corner of the blueprint.	
2. Give each student a title block to read and describe after reviewing one in a group. Each student should be able to point to the area which the title of the object is given, where everyone who draws, checks and designs the object sign, where the identification number is located, the location of the drawing number, what kind of heat treatment and finish to be given, etc. (Use Worksheets D2-D2d again.)	Worksheets D2-D2d
3. Assign the students to take the blueprints home and discuss with their parents the particular parts of the design. Have the parents sign the drawing if their child was able to identify all of the parts and explain it accurately.	

ACTIVITY	MATERIALS/RESOURCES
TASK G: Student will accurately read callouts	
1. Explain to the students that they have learned about the title blocks and now will learn about "callouts." Many industries have their own specifications of how certain parts are to be made or processed (with machines, tools, or with special cutters, etc.) The callouts provide this information. (See blueprint D1b in which callouts are on the side of the drawing.) This could be explained by showing this on an overhead projector to the group or by sharing it with an individual student. This information gives the specifications for a reamed hole and are the callouts for this part.	Overhead projector transparency of sample
2. On blueprints given previously, have the students locate the callouts for each.	Blueprints D1b
TASK H: Student will accurately read changes on blueprints	
1. Explain to the students that from time to time changes must be made in blueprints after they have been released to the shop. These changes occur for a number of reasons and the reader must understand the drawing changes in order to correctly interpret the blueprint. There are various forms of changes which may occur: an Engineering Order (EO) which is a permanent change on a separate piece of paper; a Drawing Deviation (DD) which is a temporary change; a Drawing Change Notice (DCN) which is a permanent change and results in a new drawing and a new print. The change block is usually in the upper right hand corner of the drawing and may be entitled ALTERATIONS, NOTICE OF CHANGE, or REVISIONS. A sample Notice of Change is below:	

NOTICE OF CHANGE

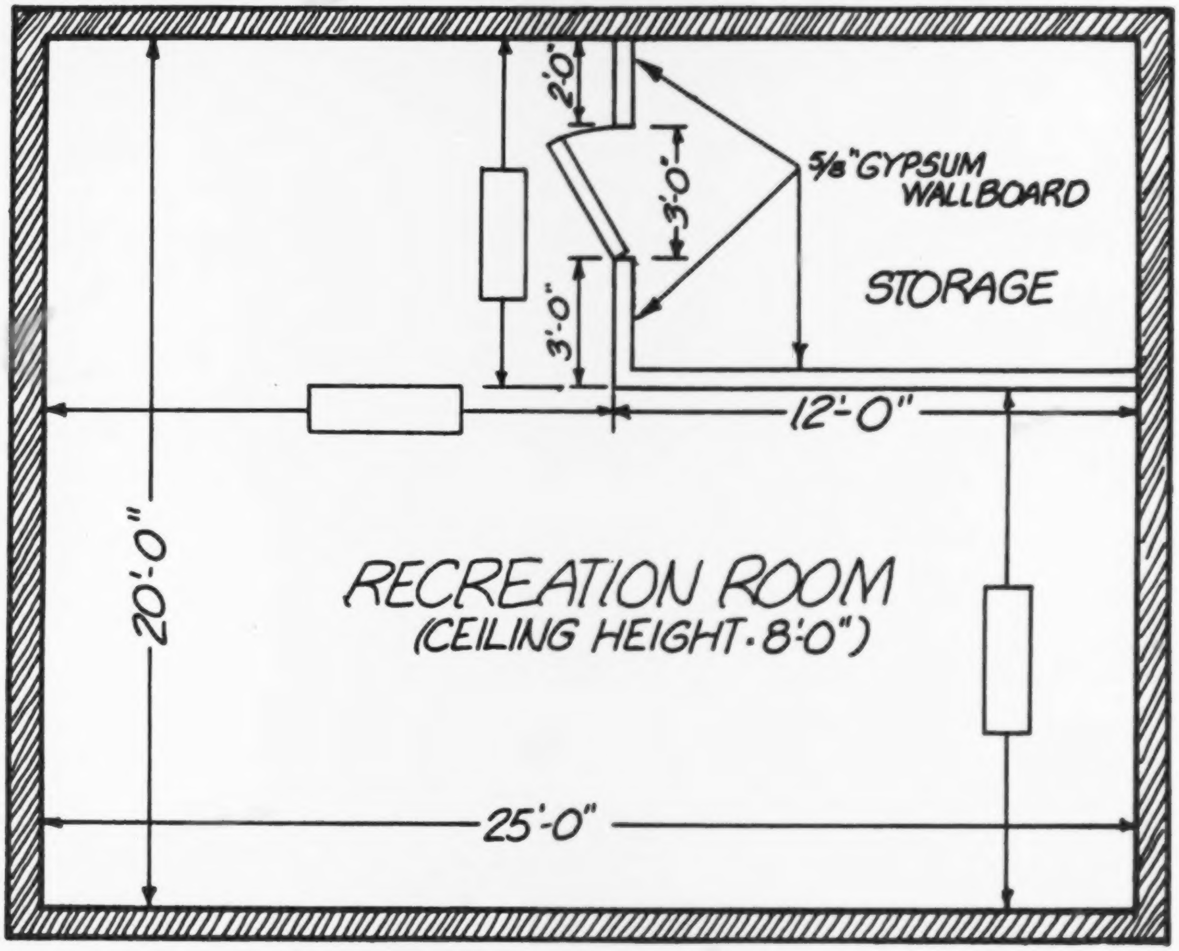
LTR	ZONE	Description	SERIAL	DATE	DR	APP

ACTIVITY	MATERIALS/RESOURCES
2. Obtain from your school drafting teacher copies of blueprints with changes on them. Ask the students to pick out the blueprints which have changes from other blueprints which do not have changes. Then ask the students to accurately read those changes on the blueprints. (This lesson is not to be able to understand each dimension, but to generally describe what is being done, e.g.: "DK made a change by marking C2 as C1 on 9/22/82 and DE approved the change.").	Copies of blueprints with changes (possibly available from the school drafting instructor)
TASK I: Student will accurately read blueprints	
1. Explain to the students that they are expected to read the basics on a blueprint at this point. Show them pictures of the blueprints they have worked with and ask them to answer questions about each as in Worksheet I1.	Worksheet I1

ACTIVITY	MATERIALS/RESOURCES
TASK I: CONTINUED	
2. After students have explained blueprints to their parents, ask them to explain them to another class member by answering questions about each blueprint. The questions could be put on standard sheets for the student to answer about each blueprint (similar to Worksheet I1).	
TASK J: Student will accurately distinguish basic terminology as given in abbreviations	
1. After reviewing several blueprints with just abbreviations ask the students why they think it might be important to know abbreviations for the standard terms. (So they can be understood by all.) Review some of the abbreviations with the students as given on Worksheet J1.	Worksheet J1
2. Have the students write the abbreviations on small index cards and mix them up. Then hold up one card at a time and see how many students can accurately identify them by either splitting the class into pairs, teams, or working individually writing the answers.	Index cards
TASK K: Student will accurately label basic architectural symbols	
1. Explain to the students that architectural symbols are used in order to identify a particular area of the room and what is to be placed there (such as a recessed tub or a built-in oven). It is important to know all of these symbols so you can accurately purchase and position the exact parts.	
2. On an overhead projector show the architectural symbols given on Worksheet K2 asking the students to try to identify what is being shown.	Overhead projector Worksheet K2
3. Give each student a sheet of paper identical to the one on the overhead and ask him/her to place the correct label under each picture.	
4. Allow the students to cut out a page of architectural symbols and mix them up trying to place them on their own blueprint. The students would enjoy designing their own rooms given these symbols.	Worksheet K2, scissors, large paper for student designed blueprint
TASK L: Student will accurately label basic electrical symbols	
1. Discuss with the students why we must know electrical and electronic symbols when drawing or reading blueprints (to know which type of outlet goes where, how to wire the house, where the telephone will be, how to lay wires, etc.)	
2. Ask students to draw symbols for some specific electronic and electrical necessities in a house. See how many they can come up with by working in small groups. Explain to the students that the symbols generally make sense. Ask specifically for a symbol for a wall fixture outlet, a push button, an antenna, a resistor, speaker, etc. These are some of the more common symbols and may be easier for the students to come up with.	Large sheets of paper for drawings, pencils

ACTIVITY	MATERIALS/RESOURCES
TASK L: CONTINUED	
3. Show students the electrical and electronic symbols from Worksheets L3 and L3a and see how many of them match the drawings given by the students.	Worksheets L3, L3a
4. Ask the students to look back at the blueprints we have studied and try to identify the symbols used in a couple of them by using this guide. Point out the likenesses in some of the symbols such as ceiling light fixture and exterior light fixture.	

Worksheet A1


2'0"
3'-0"
3'-0"
5/8" GYPSUM WALLBOARD
STORAGE
12'-0"
20'-0"
RECREATION ROOM
(CEILING HEIGHT · 8'-0")
25'-0"

BASEMENT RENOVATION SCALE $\frac{1}{4}$" = 1' PLAN

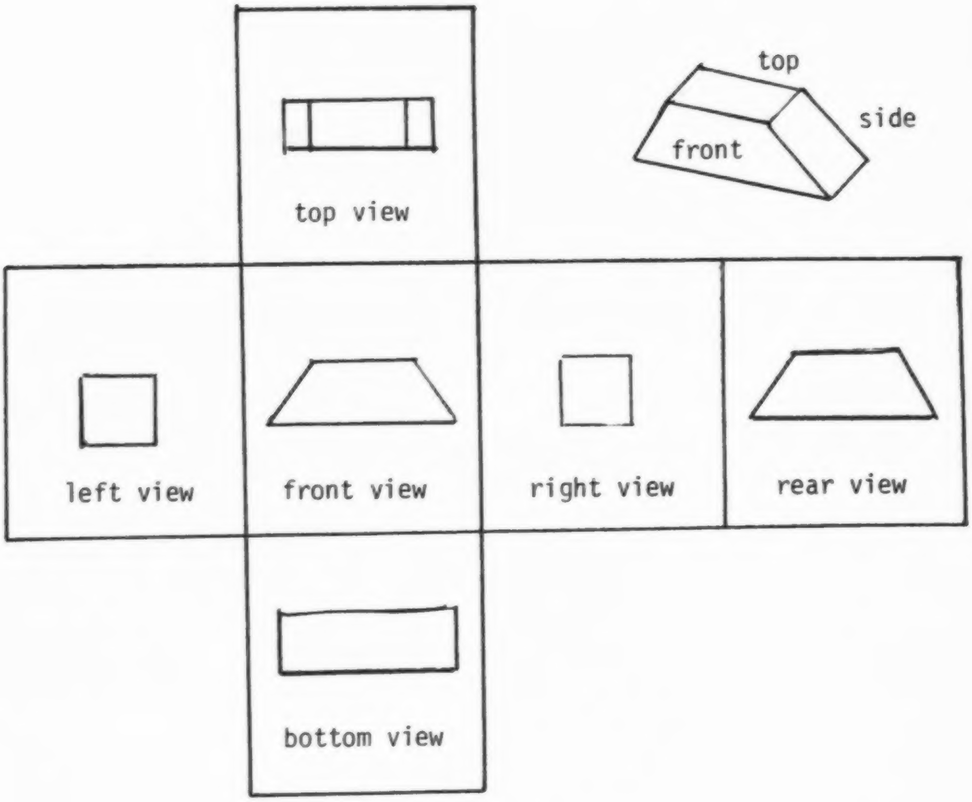
LEGEND	
▨	EXISTING 8" BLOCK
▭	NEW WALL

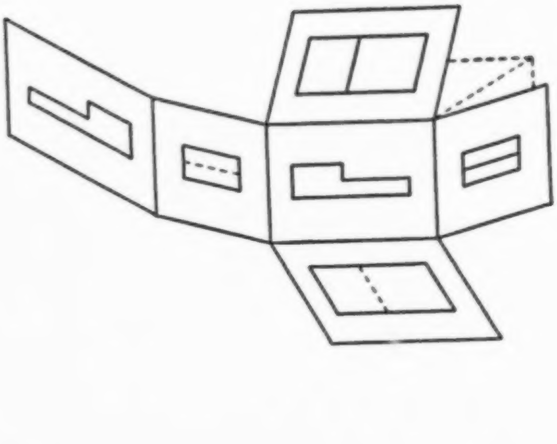
SPECIFICATIONS

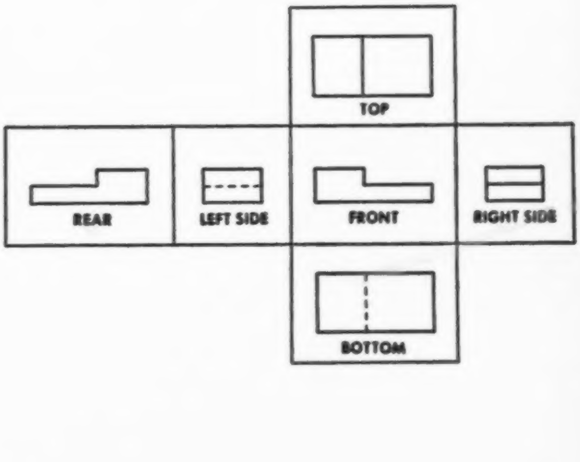
1. NEW WALLS TO BE CONSTRUCTED WITH 2×4 STUDS, 16" O.C.
2. ALL EXISTING 8" BLOCK WALLS TO BE FURRED WITH 1×2, 12" O.C. RUNNING HORIZONTALLY.
3. ALL WALLS OF REC. ROOM TO BE SURFACED WITH $\frac{1}{4}$" PRE-FINISHED PANELS.

SOURCE: Math for the Carpenter, p. 5.

Worksheet B1

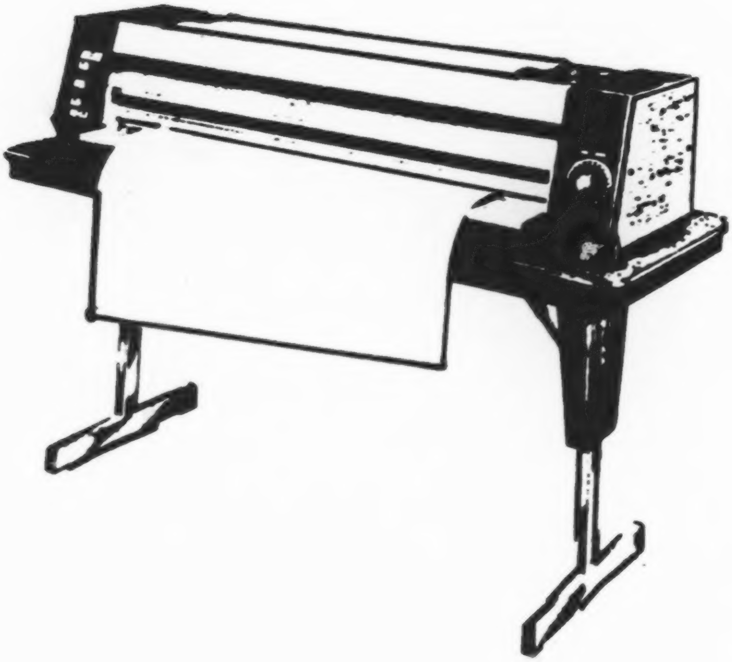

top view
left view
front view
right view
rear view
bottom view
top
side
front




TOP
REAR
LEFT SIDE
FRONT
RIGHT SIDE
BOTTOM

Worksheet C1

Print Making Machine



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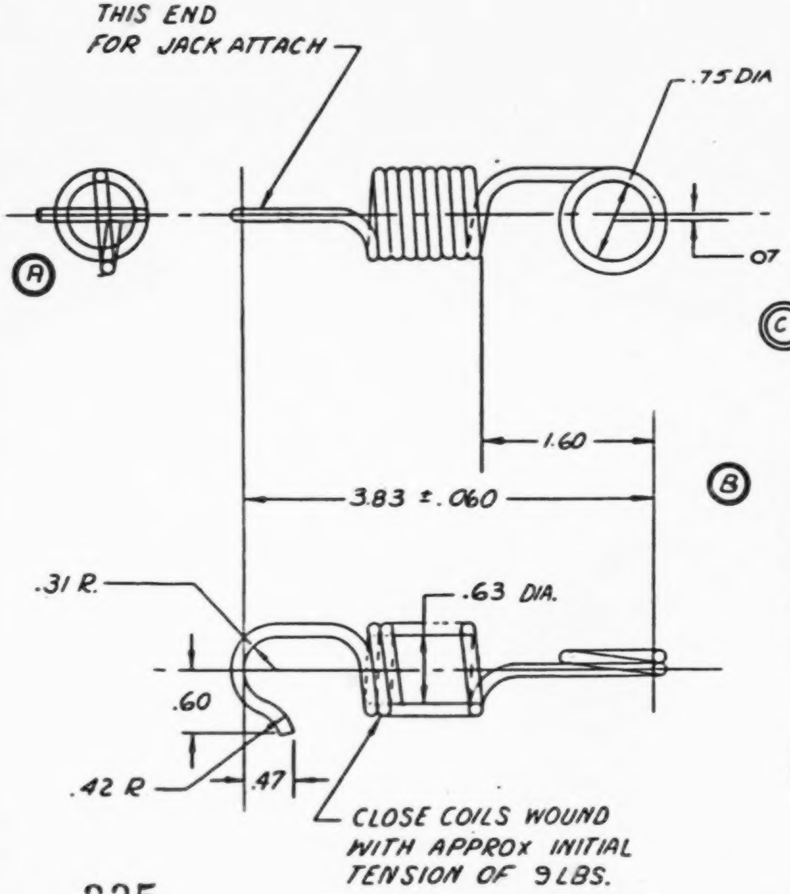
Worksheet D1a

PART NO. 11-6749

D


THIS END
FOR JACK ATTACH
.75 DIA
.07
A
C
1.60
3.83 ±.060
B
.31 R.
.63 DIA.
.60
.42 R
.47
CLOSE COILS WOUND
WITH APPROX INITIAL
TENSION OF 9 LBS.

D

MATERIAL: SPRING STEEL
M.S. 257 (HARD DRAWN)

NUMBER OF TURNS – 8

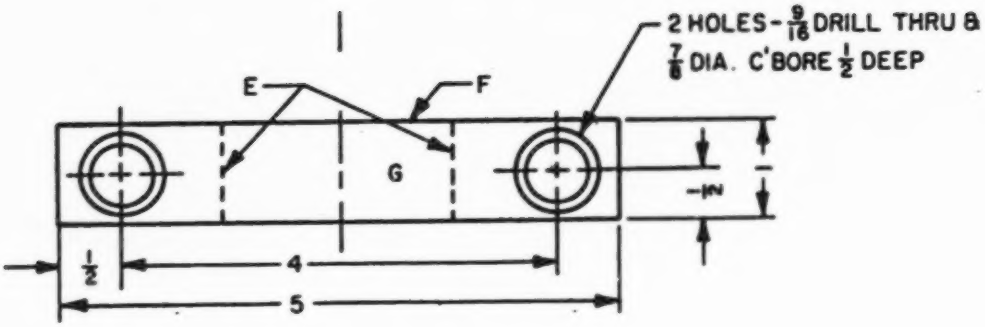
SPRING TO BE WOUND WITH
INITIAL TENSION AS NOTED

FINISH OPT.
- GALVANIZE PS. 77 BEFORE FINAL DRAW
- BLACK ENAMEL M.S. PG 13-1 P.S. 50

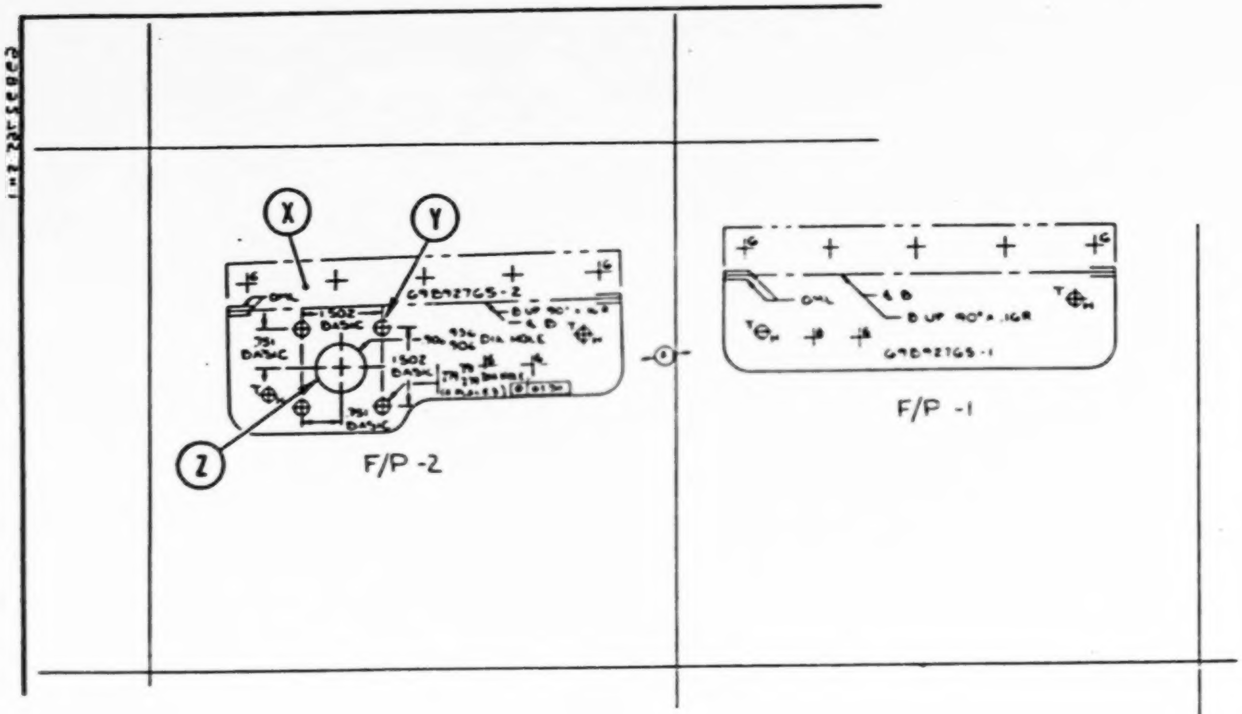
.120 DIA. OF WIRE

TOLERANCE UNLESS OTHERWISE SPECIFIED
LINEAR ±.020
ANGULAR ±0°30'
NUMBER OF DECIMAL PLACES DOES NOT IMPLY A TOLERANCE
MATERIAL NOTED
NOTED
WA2 0
BCC-R 06
DMB-H
VAUGHN
STROUG
E.V.
DATE 7-17-
DO NOT SCALE PRINT
SCALE FULL
NAME SPRING - JACK
ENGINEERING STAFF

Worksheet D1b


2 HOLES - $\frac{9}{16}$ DRILL THRU & $\frac{7}{8}$ DIA. C'BORE $\frac{1}{2}$ DEEP
E
F
G
$\frac{1}{2}$
$\frac{1}{2}$
4
5

Worksheet D1c


X
Y
Z
69B92765-2
.1502 BASIC
.751 BASIC
OML
B UP 90° x .16R
.1502 BASIC
.751 BASIC
F/P -2
OML
B UP 90° x .16R
69B92765-1
F/P -1

		—	BAC 5602	PROCESS SPEC						
		—	-3	BRACKET		.050 × 1.6 × 5.5 6061-0 SH QQ-A-250/11	—	F-25.01	R	
		—	-2	BRACKET		.063 × 3.4 × 7.6 2024-0 SH QQ-A-250/4	T42	F-17.02	R	
		—	-1	BRACKET		.063 × 2.8 × 7.6 2024-0 SH QQ-A-250/4	T42	F-17.02	R	
		QTY REQD	PART OR IDENTIFYING NUMBER	NOMENCLATURE OR DESCRIPTION	ZONE	MATERIAL AND SPECIFICATION	[illegible]	[illegible]	[illegible]	[illegible]

LIST OF MATERIALS

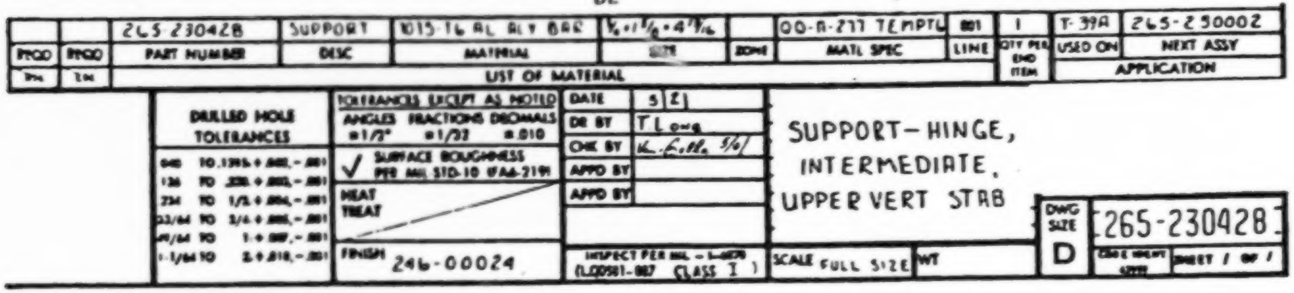
THE BOEING COMPANY

BRACKET-WATER TANK
SUMP SUPPORT

D 69B92765

Worksheets D2-D2d

D2



		265-230428	SUPPORT	7075-T6 AL ALY BAR	⅝ × 1⅝ × 4 7/16		QQ-A-277 TEMPTL	001	1	T-39A	265-250002
PROD	PROD	PART NUMBER	DESC	MATERIAL	SIZE	ZONE	MATL SPEC	LINE	QTY PER END ITEM	USED ON	NEXT ASSY
TM	TM	LIST OF MATERIAL								APPLICATION	

DRILLED HOLE TOLERANCES
.040 TO .1395 + .002, −.001
.126 TO .228 + .003, −.001
.234 TO 1/2 + .004, −.001
33/64 TO 3/4 + .005, −.001
49/64 TO 1 + .007, −.001
1-1/64 TO 2 + .010, −.001

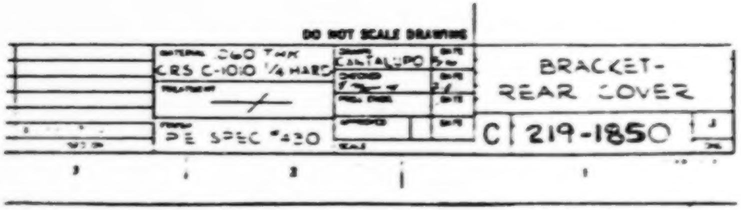
TOLERANCES EXCEPT AS NOTED
ANGLES ±1/2° FRACTIONS ±1/32 DECIMALS ±.010
✓ SURFACE ROUGHNESS PER MIL STD-10 (FA6-2191)
HEAT TREAT
FINISH 246-00024

DATE 5 21
DR BY T Long
CHK BY K. Eilla 5/61
APPD BY
APPD BY
INSPECT PER MIL – I-6870 (LQD581-087 CLASS I)

SUPPORT – HINGE,
INTERMEDIATE,
UPPER VERT STAB

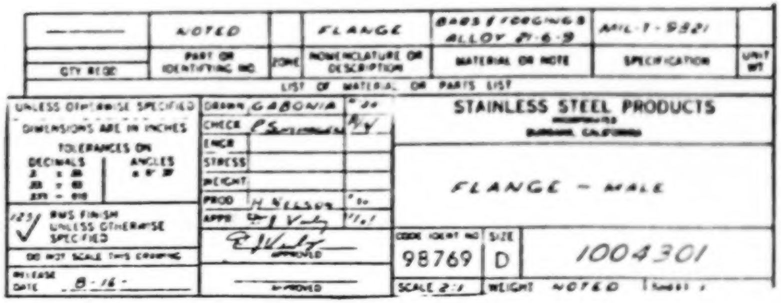
SCALE FULL SIZE
WT
DWG SIZE D
265-230428
CODE IDENT
SHEET 1 OF 1

D2a



DO NOT SCALE DRAWING
MATERIAL .060 THK CRS C-1010 ¼ HARD
TREATMENT
FINISH PE SPEC #420
DRAWN CANTALUPO
CHECKED
PROJ ENGR
APPROVED
SCALE
BRACKET –
REAR COVER
C 219-1850

D2b



———	NOTED		FLANGE	BARS & FORGINGS ALLOY 21-6-9	MIL-T-9321	
QTY REQD	PART OR IDENTIFYING NO	ZONE	NOMENCLATURE OR DESCRIPTION	MATERIAL OR NOTE	SPECIFICATION	UNIT WT
LIST OF MATERIAL OR PARTS LIST						

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS
ANGLES
✓ 125 RMS FINISH UNLESS OTHERWISE SPECIFIED
DO NOT SCALE THIS DRAWING
RELEASE DATE 8-16-

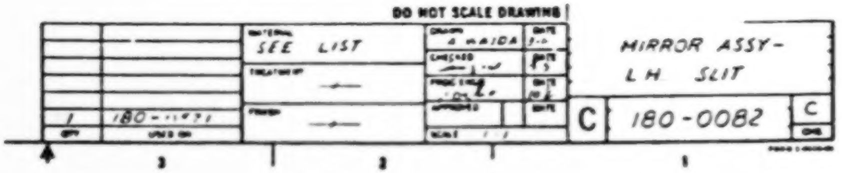
DRAWN GABONIA
CHECK P Simmons
ENGR
STRESS
WEIGHT
PROD H Nelson
APPR
APPROVED
APPROVED

STAINLESS STEEL PRODUCTS
INCORPORATED
BURBANK, CALIFORNIA

FLANGE – MALE

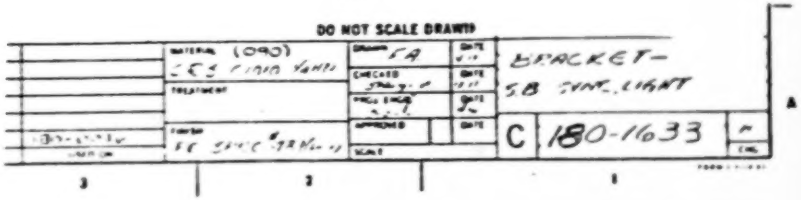
CODE IDENT NO 98769
SIZE D
1004301
SCALE 2:1
WEIGHT NOTED
SHEET 1

D2c



DO NOT SCALE DRAWING
1 180-11471
QTY USED ON
MATERIAL SEE LIST
TREATMENT
FINISH
DRAWN A HAIDA
CHECKED
PROJ ENGR
APPROVED
SCALE 1:1
MIRROR ASSY –
L H SLIT
C 180-0082 C

D2d



DO NOT SCALE DRAWING
MATERIAL (.090) CRS C1010 ¼ HARD
TREATMENT
FINISH PE SPEC #
USED ON
DRAWN FA
CHECKED
PROJ ENGR
APPROVED
SCALE
BRACKET –
SB [illegible] LIGHT
C 180-1633

Worksheet I1

Refer to the blueprint given.

1. Give the name of the part. 1. ____________

2. What is the drawing number? 2. ____________

3. What material is to be used? 3. ____________

4. How many changes have been made? 4. ____________

5. What is the part number? 5. ____________

6. Who drew the blueprint? 6. ____________

7. What is the scale of the plan? 7. ____________

8. Give two of the callouts. 8. ____________

9. ____________

10. Is the blueprint a front view, a side view, or a back view? 10. ____________

Name ____________

Worksheet J1

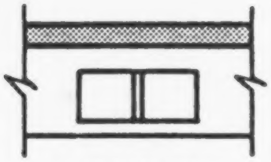
Actual	(ACT)
Adjust	(ADJ)
Advance	(ADV)
As Required	(AR)
Automatic	(AUTO)
Blueprint	(BP or B/P)
Brazing	(BRZG)
Center	(C)
Concentric	(CONC)
Control	(CONT)
Cylinder	(CYL)
Decrease	(DECR)
Degree	(DEG)
Diagonal	(DIAG)
Diagram	(DIAG)
Diameter	(DIA)
Drawing	(DWG)
Drill	(DR)
Enclosure	(ENCL)
Estimate	(EST)
Finish	(FIN)
Flexible	(FLEX)
Gallon	(GAL)
Generator	(GEN)
Ground	(GRD)
Handle	(HDL)
Head	(HD)
Identification	(IDENT)
Inch	(IN)
Increase	(INCR)
Independent	(INDEP)
Information	(INFO)
Installation	(INSTL)
Junction	(JCT)
Laboratory	(LAB)
Lacquer	(LAQ)
Laminate	(LAM)
Left Hand	(LH)
Length	(LH)
Long	(LG)
Magnesium	(MAG)
Manual	(MAN)
Maximum	(MAX)
Medium	(MED)
Middle	(MID)
Minimum	(MIN)
Miscellaneous	(MISC)
Motor	(MOT)
Number	(NO)
Opposite	(OPP)

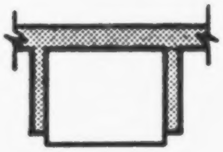
Worksheet J1 (continued)

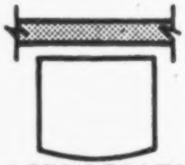
Ounce	(OZ)
Pattern	(PATT)
Positive	(POS)
Primary	(PRI)
Quality	(QUAL)
Quantity	(QTY)
Radius	(RAD or R)
Ream	(RM)
Regulator	(REG)
Required	(REQD)
Right Hand	(RH)
Schedule	(SCH)
Section	(SECT)
Serial	(SER)
Specifications	(SPEC)
Thick	(THK)
Tolerance	(TOL)
Volt	(V)
Watt	(W)

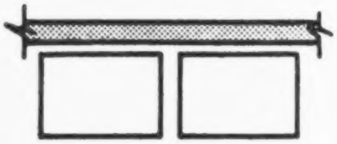
Worksheet K2

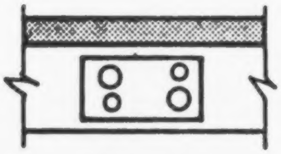
Architectural Symbols

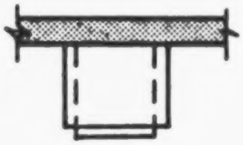

KITCHEN SINK

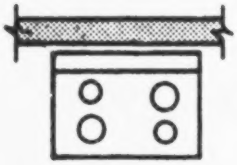

BUILT-IN REFRIGERATOR

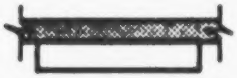

REFRIGERATOR (FREE STANDING)

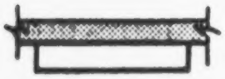

WASHER DRYER

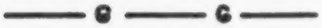

BUILT-IN COOKING TOP


BUILT-IN OVEN

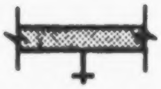

RANGE

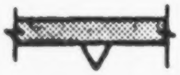

RADIATOR

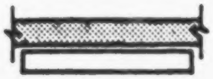

CONVECTOR

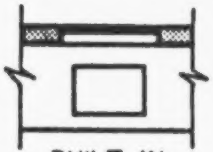


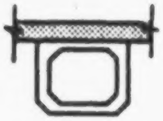
GAS LINE

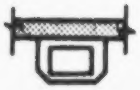

HOSE BIB

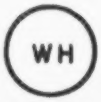

VACUUM OUTLET


BASEBOARD RADIATOR

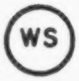

BUILT-IN LAVATORY


WALL LAVATORY

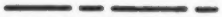

DENTAL LAVATORY

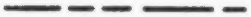


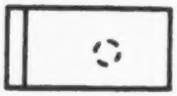
WATER HEATER

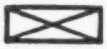


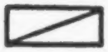
WATER SOFTENER

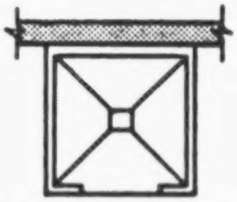

COLD WATER LINE

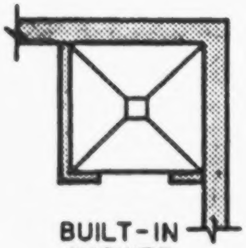

HOT WATER LINE


HEATING UNIT

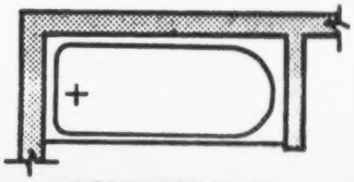

SUPPLY AIR DUCT

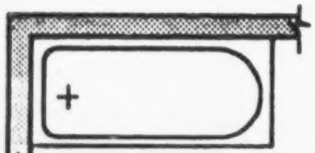

RETURN AIR DUCT

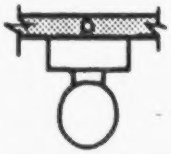

SHOWER STALL


BUILT-IN SHOWER

FLOOR DRAIN

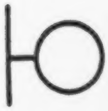

RECESSED TUB

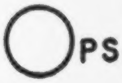

CORNER TUB


STOOL

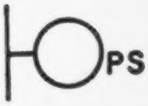
Worksheet L3

Electrical Symbols

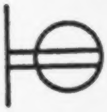

WALL FIXTURE OUTLET

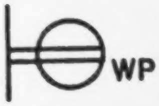


CEILING OUTLET WITH PULL SWITCH

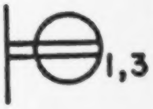


WALL OUTLET WITH PULL SWITCH

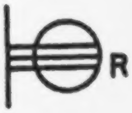

DUPLEX CONV'N OUTLET



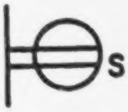
WATERPROOF CONV'N OUTLET



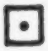
CONV'N OUTLET 1= SINGLE, 3=TRIPLE

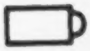


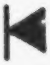
RANGE OUTLET

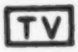


CONV'N OUTLET WITH SWITCH

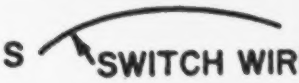

PUSH BUTTON


BELL

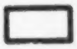

OUTSIDE TELEPHONE CONNECTION

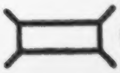


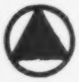
TELEVISION CONNECTION

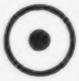


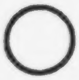
SWITCH WIRING

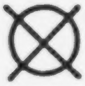

EXTERIOR CEILING FIXTURE

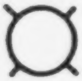

FLUORESCENT CEILING FIXTURE


SPECIAL PURPOSE (SEE SPECS.)


FLOOR OUTLET


CEILING OUTLET


CEILING LIGHT FIXTURE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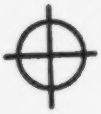
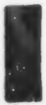
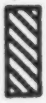
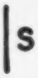
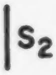

EXTERIOR LIGHT FIXTURE


LIGHTING PANEL

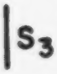

POWER PANEL



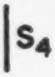
SINGLE-POLE SWITCH



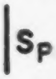
DOUBLE-POLE SWITCH



THREE-WAY SWITCH



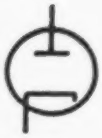
FOUR-WAY SWITCH



SWITCH WITH PILOT LIGHT

Worksheet L3a

Electronic Symbols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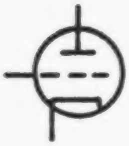
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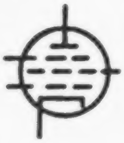
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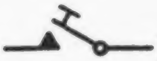
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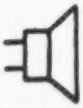
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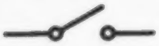
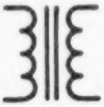
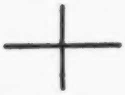
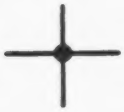

SWITCH


TRANSFORMER


WIRES CROSS
NOT CONNECTED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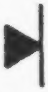
CONNECTED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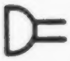
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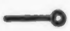
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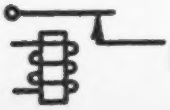
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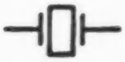
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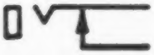
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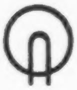
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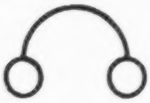
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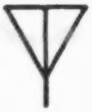
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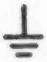
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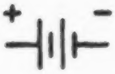
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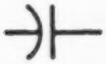
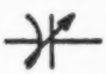

FIXED
CAPACITOR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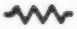
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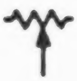
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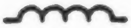
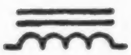

INDUCTOR
AIR CORE


INDUCTOR
IRON CORE